Vol. XXII SEPTEMBER–OCTOBER, 1922 No. 5

NATURAL HISTORY

JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

ANNUAL SUBSCRIPTION $3.00 SINGLE COPIES 50 CENTS
FREE TO MEMBERS AND ASSOCIATE MEMBERS OF THE MUSEUM

The American Museum of Natural History

SCIENTIFIC STAFF

FREDERIC A. LUCAS, SC.D., Director
ROBERT C. MURPHY, Assistant to the Director (in Scientific Correspondence, Exhibition, and Labeling).
JAMES L. CLARK, Assistant to the Director (in Full Charge of Preparation).

DIVISION OF MINERALOGY AND GEOLOGY

W. D. MATTHEW, F.R.S., Curator-in-Chief

Geology and Invertebrate Palæontology

EDMUND OTIS HOVEY, PH. D., Curator
CHESTER A. REEDS, PH.D., Associate Curator of Invertebrate Palæontology.

Mineralogy

HERBERT P. WHITLOCK, C.E., Curator
GEORGE F. KUNZ, PH. D., Research Associate, Gems

Vertebrate Palæontology

HENRY FAIRFIELD OSBORN, LL.D., D.SC., Honorary Curator
W. D. MATTHEW, PH. D., Curator
WALTER GRANGER, Associate Curator of Fossil Mammals
BARNUM BROWN, A.B., Associate Curator of Fossil Reptiles
WILLIAM K. GREGORY, PH.D., Associate in Palæontology

DIVISION OF ZOÖLOGY AND ZOÖGEOGRAPHY

FRANK MICHLER CHAPMAN, N.A.S., Curator-in-Chief

Lower Invertebrates

ROY W. MINER, PH.D., Curator
WILLARD G. VAN NAME, PH.D., Assistant Curator
FRANK J. MYERS, Research Associate, Rotifera
HORACE W. STUNKARD, PH.D., Research Associate, Parasitology
A. L. TREADWELL, PH. D., Research Associate, Annulata

Entomology

FRANK E. LUTZ, PH.D., Curator
A. J. MUTCHLER, Assistant Curator in Coleoptera
FRANK E. WATSON, B.S., Assistant in Lepidoptera
JOSEPH BEQUAERT, PH.D., Assistant in Congo Zoölogy
CHARLES W. LENG, B.S., Research Associate, Coleoptera
HERBERT F. SCHWARZ, A.M., Research Associate, Hymenoptera
WILLIAM M. WHEELER, PH.D., Research Associate, Social Insects

Ichthyology

BASHFORD DEAN, PH.D., Honorary Curator
JOHN T. NICHOLS, A.B., Associate Curator of Recent Fishes
E. W. GUDGER, PH.D., Associate in Ichthyology

Herpetology

G. KINGSLEY NOBLE, PH.D., Associate Curator (In Charge)
ARTHUR ORTENBURGER, M.S., Assistant Curator

Ornithology

FRANK M. CHAPMAN, SC.D., Curator
W. DEW. MILLER, Associate Curator
ROBERT CUSHMAN MURPHY, D.SC., Associate Curator of Marine Birds
JAMES P. CHAPIN, A.M., Assistant Curator, African Birds
LUDLOW GRISCOM, M.A., Assistant Curator
JONATHAN DWIGHT, M.D., Research Associate in North American Ornithology
MRS. ELSIE M. B. REICHENBERGER, Research Assistant

Comparative Anatomy

WILLIAM K. GREGORY, PH.D., Curator
S. H. CHUBB, Assistant in Osteology
J. HOWARD MCGREGOR, PH.D., Research Associate in Human Anatomy

Mammalogy

ROY C. ANDREWS, A.M., Associate Curator of Mammals of the Eastern Hemisphere
H. E. ANTHONY, A.M., Associate Curator of Mammals of the Western Hemisphere
HERBERT LANG, Assistant Curator, African Mammals
CARL E. AKELEY, Associate in Mammalogy

DIVISION OF ANTHROPOLOGY

CLARK WISSLER, PH. D., Curator-in-Chief

Anthropology

CLARK WISSLER, PH.D., Curator
PLINY E. GODDARD, PH.D., Curator of Ethnology
N. C. NELSON, M.L., Associate Curator of North American Archæology
CHARLES W. MEAD, Assistant Curator of Peruvian Archæology
LOUIS R. SULLIVAN, A.M., Assistant Curator, Physical Anthropology
CLARENCE L. HAY, A.M., Research Associate in Mexican and Central American Archæology

Comparative Physiology

RALPH W. TOWER, PH. D., Curator

Comparative Anatomy

WILLIAM K. GREGORY, PH.D., Curator
J. HOWARD MCGREGOR, PH.D., Research Associate in Human Anatomy

DIVISION OF EDUCATION, BOOKS, PUBLICATION, AND PRINTING

GEORGE H. SHERWOOD, A.M., Curator-in-Chief

Library and Publications

RALPH W. TOWER, PH.D., Curator
IDA RICHARDSON HOOD, A.B., Assistant Librarian

Public Education

GEORGE H. SHERWOOD, A.M., Curator
G. CLYDE FISHER, PH. D., Associate Curator
RUTH CROSBY NOBLE, B.A., Assistant Curator
GRACE FISHER RAMSEY, Assistant Curator

Public Health

CHARLES-EDWARD AMORY WINSLOW, D.P.H., Honorary Curator
MARY GREIG, Assistant

Natural History Magazine

HERBERT F. SCHWARZ, A.M., Editor

ADVISORY COMMITTEE

GEORGE H. SHERWOOD, A.M., (Ex-officio)
FRANK M. CHAPMAN, SC.D., Curator-in-Chief, Division of Zoölogy and Zoögeography
W. D. MATTHEW, PH.D., Curator-in-Chief, Division of Mineralogy and Geology
CLARK WISSLER, PH.D., Curator-in-Chief, Division of Anthropology

Copyrighted by Byron Harmon, Banff, Canada

A MONARCH OF THE PLAINS DEPOSED BY CIVILIZATION

One of the last of his race, this old bison bull might almost seem to be mourning the sad history of the bison in its final chapter. Photograph reproduced through the courtesy of Mr. Le Roy Jeffers, Secretary of the Associated Mountaineering Clubs of North America

NATURAL HISTORY

VOLUME XXII SEPTEMBER-OCTOBER, 1922 NUMBER 5

CAN WE SAVE THE MAMMALS?

BY

HENRY FAIRFIELD OSBORN AND HAROLD ELMER ANTHONY

The American Museum of Natural History is working hand in hand with the New York Zoölogical Society, with the Boone and Crockett Club, with the American Game Protective Association, with the American Bison Society, and the National Association of Audubon Societies, with the United States Biological Survey of Washington, with the National Parks Service of the United States Department of the Interior, with the American Society of Mammalogists, and with officers of the British, of the Indian, of the Australian, and of the British Colonial and Insular governments, to retard the inevitable CLOSE OF THE AGE OF MAMMALS. This title, chosen for a forthcoming statistical article[1] by the present authors, is not the cry of the alarmist; it is the expression of an actual and most melancholy fact, namely, that the glorious AGE OF MAMMALS is closing, that man will soon be alone amid the wreck of creation; that many of the races of man himself are passing under the inexorable law of extinction. The title of the present article, "CAN WE SAVE THE MAMMALS?," is designed to strike a note of hope as to what yet may be accomplished toward salvaging for the future the little that remains of the wreck of the past.

FORTY years ago the birds of the world were in great danger of extinction, partly because of the ruthlessness of the man with the gun whom we will not designate a sportsman; partly because of the frivolous demands of the equally ruthless woman of fashion. As a glorious reward to the friends of the Audubon Societies in America and of the Plumage Bill Group and similar societies in Great Britain, the birds have been saved in English-speaking countries. Irresponsible destruction of game birds has been checked all over the North American continent and birds of all kinds are now multiplying. The destruction of birds of beauty and of song for the relentless purposes of fashion has been stopped so far as North America is concerned, and has recently been arrested all over the British Empire; it remains to check and stop it in the Latin countries. Not yet can it be said, however, that the birds of the world have been saved, because destruction of the superb pheasant family (Phasianidæ) of Eastern Asia and of the still more brilliant birds of paradise (Paradiseidæ) of New Guinea and adjacent islands is still proceeding with alarming rapidity.

The saving of the birds renders us hopeful that certain of the finest kinds of mammals, including those which are nearing extinction from natural causes, as well as many of the fur bearers that have been reduced in numbers through persistent persecution, can still be saved by three great movements along lines similar to those which have resulted in the preservation of the birds and of certain forests.

First, we may point out the alarming rate at which the mammals are now being slaughtered for commercial purposes and demonstrate that such devastating measures are ill-advised in that they are defeating their own ends. By pointing out the inevitable consequences of the rapid destruction of trees, conservationists were able to save some of the historic forests of Europe and of America. Those championing the right of survival of our game animals may in like manner refer to the fact that the unchecked destruction of any natural species, whether it be a *tree*, a *bird*, or a *mammal*, may mean an immediate monetary gain to a few individuals, but must mean ultimate monetary loss, not to mention *moral* and *spiritual* loss, to the entire community, while posterity is thereby robbed for all time of what should rightly be part of its heritage.

The *second* measure in this great

[1] *Journal of Mammalogy*, November, 1922

THE PRONGHORN ANTELOPE

This animal faces extermination today and with its disappearance will go one of our most typical North American mammals

conservation movement is again similar in character, whether it concerns trees, birds, or mammals: it is designed to prove that the final destruction of a species is against the general welfare, that it is unnecessary because stimulated by entirely *artificial* and not by real human needs. We cannot deny fur clothing to the Eskimo, a fur coat to the northern woodsman, the reasonable use of furs in civilized communities for dress and for ornament, any more than we can deny the reasonable use of trees for economic purposes, or of birds as a natural source of food supply. It is not the reasonable use of mammals which is bringing the great AGE OF MAMMALS to a close; it is the unnatural uses created by entirely artificial means, such as the wearing of furs purely as a means of display of wealth and for the purpose of gaining social position or standing.

Our *third*, and what may ultimately prove to be our most effective, measure in trying to save the mammals is that which has been applied to such advantage in the case of the birds, namely, creation among our school children of the sentiment of conservation, of the love of nature, of the appreciation of the wonder and beauty of mammalian life, of the realization of the great efforts which nature has put forth to produce the mammal kingdom, and of the enormous periods of time that have been required for its evolution; the sentiment, moreover, that mammals are the friends of man, that they are prototypes of our strength as well as our weakness, that they are among our best companions, that even some of the wildest of animals will become tame and companionable as soon as the gun of the market hunter and that of the sportsman are silenced.

These three watchwords of the mammal conservation movement are like the little flags known as guidons which direct lines of cavalry both in army maneuvers and in battle. Conservation is, in fact, partly a matter of skillful maneuvering following a long period of preliminary public education; it is also partly a matter of downright warfare. Some veterans, like the dean of American conservationists, Dr. W. T. Hornaday, always sound the battle cry; others, like the late lamented C. Gordon Hewitt, leader of the conservation forces in Canada, try to advance by the gentler methods of conciliation and of education. To save the mammals it is certainly necessary to marshal all our forces, both militant and persuasive, and to use all or any of these methods.

To enlist the coöperation of the readers of NATURAL HISTORY, let us present as our first line of attack some of the actual facts of the present period of slaughter which lead us to believe that unless there is a drastic change of action the AGE OF MAMMALS is surely coming to a close.

ELIMINATION OF THE FUR AND HIDE-BEARING ANIMALS AT THE RATE OF THIRTY MILLION A YEAR*

Nothing in the history of creation has paralleled the ravages of the fur and hide trade, which, with the bone fertilizer trade, now threatens the entire vertebrate kingdom. Furs are no longer worn primarily for protection in cold weather. Furs are now a fashion, just as feathers were forty years ago. The trade has passed almost entirely into the hands of people of Oriental and Asiatic origin. Millions of dollars are spent annually in advertising. Furs are worn in midsummer purely for personal adornment, or to make a display of wealth and luxury.

Some realization of the destruction now going on among the mammals is afforded by a glance at the statistics of our fur trade. After consulting a great number of fur-trade journals and reports, Mr. Anthony has compiled figures for the years 1919, 1920, and 1921, showing the large number of skins sold all over the United States at the fur auctions. The

*This section of the present article is taken, with slight modification, from the article by the same authors that will appear in the *Journal of Mammalogy*, November, 1922.

best of these journals is the *Fur Trade Review*, a large monthly publication given over to everything of interest to the fur dealer. In the *Fur Trade Review* one can find a list of all offerings at the different fur auctions, and it may be assumed that these figures are sufficiently authentic to be used in this article. In interpreting data of this nature, there are several features to be kept in mind. It is possible that the records of skins sold during any one year will not be a true record of the actual killing for the period in question, inasmuch as, during a time of high prices, skins may be brought out of storage to be marketed under favorable conditions. A large number of skins sold during a certain year may, therefore, have been collected over a period of several years. However, as we have had a few "boom" years, it is quite likely that all of such stored skins were brought out sometime ago and disposed of, so that the more recent figures probably indicate animals killed within a year of their sale. Furthermore, lots of skins may be sold at a spring auction and shipped to another part of the country to be resold in the fall, thus giving a duplication of numbers. However, omission of the winter sales of 1921 from this list more than offsets any duplication that may have occurred.

The discounted total of all skins sold for the three years in question reaches the alarmingly large figure of 107,689,927 skins. Moreover, this figure indicates only the slaughter of the animals which reached the market as skins. To show properly the actual slaughter that is taking place, one must allow for animals that were killed but not sent to the market because their skins were unprime, also for a considerable percentage

Photograph by H. E. Anthony

Anyone who loves mammals will find in the raccoon a most fascinating pet, a little mischievous at times but possessed of disarming friendliness. Unfortunately most people know this animal best as a popular fur and so miss all of the bright, lively fun that tingles in the tips of his almost human fingers

of wounded animals which, although they escaped the hunter, were killed nevertheless, through his agency. A glance at some of the more noteworthy species sought by the fur trade that are indicated in the following table will show something of the scope and demands of this industry. Altogether the fur trade utilizes, at the very least, about one hundred twenty-five species, the exact number being difficult to determine because of the employment of trade names, which mean nothing to the zoölogist. Mr. Anthony has included in the table only thirty-two of the more important species out of the one hundred twenty-five species which are being destroyed.

THE RODENTS AND INSECTIVORES OF AMERICA AND EUROPE

A glance at the figures showing the number of skins of beaver (*Castor canadensis*) sold demonstrates what proper protection of a fur-bearing species may accomplish. Formerly trapped all over

POPULAR NAMES OF THE ORIGINAL FUR BEARERS WHICH HAVE BEEN SOLD DURING THE PAST CENTURY	SCIENTIFIC NAMES OF THE SAME FUR BEARERS	TOTAL NUMBERS BOUGHT OR SOLD BY THE FUR TRADE DURING THE YEARS 1919, 1920, 1921
Beaver	*Castor canadensis*	420,490
Chinchilla	*Chinchilla lanigera*	36,448
Mink	*Putorius vison*	2,540,971
Fisher	*Martes pennanti*	32,014
Marten	*Mustela americana*	309,808
Ermine	*Putorius arcticus*	3,492,412
Sable	*Mustela zibellina*	57,908
Fur Seal	*Callorhinus alascanus*	85,164
Red Fox	*Vulpes fulvus*	1,295,258
Cross Fox	" "	32,296
Silver Fox	" "	26,350
Land Otter	*Lutra canadensis*	111,059
Sea Otter	*Latax lutris*	76
	Total	8,440,254

FUR BEARERS RECENTLY INTRODUCED BY THE FUR TRADE TO REPLACE THE DIMINISHING ORIGINAL FUR BEARERS

POPULAR NAMES	POPULAR TRADE NAMES	SCIENTIFIC NAMES	TOTAL DURING 1919-21
Muskrat	Hudson Seal	*Fiber zibethicus*	14,109,288
Nutria	Nutria	*Myocastor coypu*	1,941,784
Squirrel	Squirrel	*Sciurus vulgaris*	14,858,316
Marmot	When dyed, as Mink or Sable	*Marmota sp.*	3,107,759
White Hare	French Sable or Electric Seal	*Lepus sp.*	3,713,036
Mole	Mole	*Talpa sp.*	23,801,905
Stone Marten	Stone Marten	*Mustela foina*	107,075
Red Sable	Kolinsky	*Mustela sibirica*	1,151,553
Skunk	Skunk	*Mephitis sp.*	6,895,674
European Polecat	Fitch or Sable	*Mustela putorius*	1,094,411
Wolf	Wolf	*Canis sp.*	1,094,502
White Fox	White Fox	*Alopex lagopus*	166,071
Bobcat	Lynx	*Lynx rufus*	191,799
Raccoon	Raccoon or, dyed, as Lynx	*Procyon sp.*	1,713,700
American Opossum	Opossum	*Didelphys virginiana*	9,787,742
Australian Opossum	"	*Phalanger sp.*	4,265,621
Ring-tailed Opossum	"	*Pseudochirus and Phalanger sp.*	1,321,625
Koala[1]	Wombat	*Phascolarctus cinereus*	208,677
Wallaby	Kangaroo	*Macropus sp.*	1,722,588
		Total	91,253,126

[1]Technically the Koala and the Wombat are different, but the Koala is classed as "Wombat" in fur circles.

the American continent, beaver were brought almost to the verge of extermination, but for many years they have been protected and allowed to increase unmolested. As a result, during the period of the past three years, about 420,000 skins have come to the market.

The table indicates how relentless has been the pursuit of the muskrat (*Fiber zibethicus*), an animal which at one time brought such a low price at the sales that it was scarcely worth while to trap it; when muskrat fur came into fashion under the trade name of "Hudson seal," and the public demanded it, a systematic campaign of trapping began, which brought muskrat skins to the market by the millions and now seriously threatens the very existence of this species. Squirrel (*Sciurus*) skins, most of which, we believe, have come from the Old World, make up a huge total of more than 14,000,000, and this is another example of a skin, formerly valued very slightly, that has come into prominence because of the demands of fashion. Skins of the insectivorous moles (*Talpa*) reach even a larger aggregate. The skin of the mole is so small that only since the passion for furs has become extreme has there been any incentive for men to molest this animal. Most of the skins disposed of at the sales tabulated on p. 393 must have come from the Old World, and the mole, as anyone knows who has tried to trap it, is an exceedingly difficult animal to capture. More than 23,000,000 of these little animals were sacrificed to the insatiable demands of the fur trade. The mole, it may be claimed, is a small, insignificant species, and here and there among the list of fur bearers are other animals for which no economic value may be urged, but the presentation of this subject is intended to show the great destruction of mammal life, irrespective of species, and the possible desirability of exterminating any particular animal does not enter into the discussion.

THE SMALL CARNIVORES OF THE FOREST

The mink (*Putorius vison*), which was one of the first fur-bearers to be trapped in this country and which has remained a favorite for the past century, is an animal that apparently nowhere survives in very great numbers. However, since its skin has brought such a good price at auctions, our country has been combed over for mink, and the annual average yield of the last three years has risen to more than 500,000 skins. This is a very serious, if not fatal, tax upon the ability of the animal to maintain itself. The winter fur of the ermine (*Putorius arcticus*) has been worn from time immemorial and has been the fur of royalty. Today its use is much more general, witness the fact that no less than 4,400,000 skins of these little animals have come to the market during the three-year period. Before the recent craze for furs had begun, the skunk (*Mephitis*) enjoyed the immunity which nature intended him to have, and his skin brought such a low figure at the auctions that it scarcely paid anyone to run the risk of removing it. Now skunk fur commands such a high price that the trappers have covered all the American forests and plains area and more than 6,000,000 skins of this animal were disposed of at the auctions held from 1919 to 1921.

The raccoon (*Procyon*) is another animal the fur of which had but little value in early years; but to show how its status has changed, it will be necessary only to point out the total sales for the three-year period, amounting to 1,700,000 skins. One of the furs most widely sold today was formerly worth but a few cents,—we refer to the American or Virginia opossum (*Didelphys virginiana*). In those days there were few individuals other than boys who would give their time to skinning it, but since it has come into fashion, a vast number of market hunters have been occupied in obtaining the more

A GOOD OLD-FASHIONED FAMILY

The prolific opossum can withstand the aggressions of enemies far better than most other mammals and doubtless will be one of the few survivors when the mammals stand in the last ditch against the forces of modern civilization

than 9,700,000 skins subsequently placed on sale.

The average man has been led to suppose that wolves of the forests and plains have become almost extinct over most of the country. In the figures given for the wolf (*Canis lupus*), there are lumped together a great many species of coyotes and wolves, but, even so, the very large total of more than

1,000,000 skins is very significant of the great campaign that is being carried on against this animal, and at this rate it will not be very long before the wolf is extinct indeed. The red fox (*Vulpes fulvus*) has been such a prime favorite that great numbers of skins of this animal have come to the fur sales, and we understand that in some regions of the north the fox is virtually on the brink of extermination. More than 1,200,000 skins taken during the three-year period evidence a rate of destruction far greater than that which an animal like the fox can survive. On the other hand, the rarer foxes, the silver and the black, have been protected and reared in captivity, and we have learned upon good authority that most of the skins sold are those of ranch-reared animals. The fact that it was possible during the three-year period to place on the market the skins of more than 26,000 ranch-reared foxes furnishes a clew as to the proper methods for supplying the fur market.

CARNIVORA OF THE SEA

The sea otter (*Latax lutris*), which furnishes the most beautiful of all furs, was represented on the fur counters by only seventy-six pelts—a sad commentary on the disappearance of this animal. Inasmuch as the sea otter is protected over most of its known range, some of the skins were doubtless taken illegally and unless some radical change for the better takes place, it will no longer be obtainable by the fur dealers. When the killing of the Alaskan fur seal (*Callorhinus alascanus*) had reached such serious proportions that the government found it necessary to intervene, and treaties were entered into establishing the right of this country to protect this animal, the northern herds were placed under supervision and the annual killing controlled by law. This regulation has worked out most satisfactorily, and a glance at the figures shows that over the three-year period more than 85,000 skins were sold—a very satisfactory

Photographed by Roy Chapman Andrews

Alaskan fur seal in a rookery protected by the United States Government

total when one considers the high price commanded by the individual skin.

DEVASTATION OF FUR BEARERS IN AUSTRALIA

The Australian marsupials have known to their cost the increased demand for opossum, and the drain upon the wild life of Australia is shown by the marketing of a total of more than 4,000,000 skins of the so-called "Australian opossum,"—several species of small marsupials (*Phalanger*) going under this name—a total of more than 1,300,000 skins of the ring-tailed opossum (*Phalanger* and *Pseudochirus*), and more than 208,000 skins of the koala (*Phascolarctus cinereus*), or marsupial bear. As to the inroads by pelt hunters ". . . the Queensland Minister for Agriculture has said that in 1919–1920 no fewer than five and a quarter million 'possums and a million native bears were slaughtered in Queensland."

The Australian naturalists have been desirous of conserving their wild life and have shown this in their restriction of the number of native mammals which they have allowed scientific expeditions to take out, but, on the other hand, their trappers and traders have shipped out through the principal ports literally ton upon ton of baled skins, and whole regions have been stripped of mammal life, so that Mr. W. H. Dudley LeSouef, of the Sydney Zoölogical Park, says that some of the species have been brought down so close to the danger point that a year of drought will exterminate them completely over large areas.

Curator Gregory[1], who has recently returned from a tour of observation in Australia, writes: "The principal causes for the rapid extinction of marsupial mammals in Australia, as far as I could learn while there, are as follows: (1) The process of clearing the land over thousands of miles, by ringing, chopping and burning the trees, not only destroys the arboreal marsupials but practically sterilizes the burned district. The progress in clearing the land is extremely rapid, as may be seen in riding over thousands of miles in Queensland, Victoria, New South Wales, and South Australia. (2) The introduced rabbits, which in some districts are present in enormous numbers, naturally tend to crowd out the native fauna. (3) Foxes, introduced first to kill off the rabbits, take a heavy toll of the marsupials. The poison used to kill the foxes does more damage. (4) My companion, Mr. Raven, found that the dingoes (*Canis dingo*) had nearly cleaned out the ground-living marsupials in the deep mountain ravines of the Guy Fawkes region in northern New South Wales. (5) The koala (*Phascolarctus*) has been the subject of a devastating plague, which made them extremely rare in Queensland, in localities where they were formerly very abundant. In spite of all this, my impression is that the marsupial fauna of Australia as a whole is far from being exterminated, especially in the less settled districts of the great continent. The proposed establishment of great state parks and sanctuaries, even if it does not fully protect the animals from fur hunters, will give them a protection from the deadly fires and from the destruction of their natural environment."

AN INDUSTRY DESTINED TO BE SHORT LIVED

The figures just cited give a little insight into what the fur trade is doing toward bringing about the close of the AGE OF MAMMALS. In a few years some of the mammals now sought by the trappers will be killed off to a point where they will not repay trapping, the numbers taken being insufficient to justify the expenditure of time and effort. Meanwhile, America has become the center of the fur trade. Before the war London was the world's fur market, but it now appears that the control has

[1]Gregory, W. K., "Australian Mammals and Why They Should Be Protected." *Australian Museum Magazine*, Vol. 1, No. 3, p. 65. December, 1921.

passed to the United States, and the great market of the present day is here.

The figures given out by the Fur Dressers and the Fur Dyers Association show that in New York City alone more than 80,000,000 skins were dressed and more than 97,000,000 were dyed by the members of this association during 1918, 1919, and 1920. Thus it would appear that the life of this industry throbs in our own country, and if any proscription is to be written, such as may serve to prolong the trade itself, the initiative should be taken by America. The more intelligent fur dealers realize that the wild animals are an asset to their industry, and judging by the editorials of the different journals, and the articles that appear, we believe that the majority of such fur dealers, if the matter were put to a vote, would encourage more humane methods of trapping and a more extended control over the wild animal supply. It would suit their own purposes better if animals could be taken only during that part of the winter when the furs are in their prime; the restriction of the hunting period to such a time of the year would be an important step toward the conservation of fur bearers. But as matters now stand, when fur prices begin to mount to such figures that a few skins represent many dollars, then in the out-of-way places where laws have but little significance at any season of the year, men go out and kill every fur bearer that they come upon, and run out their traps for whatever they may catch. Therefore, we believe that if some more intelligent and humane methods of checking this appalling slaughter are not soon inaugurated, the fur craze will have been the means not only of closing the AGE OF MAMMALS but of terminating a great industry.

RAPID EXTERMINATION OF THE GREAT MAMMALS OF AFRICA[1]

As regards organized destruction of animals to supply pelts for the fur trade, Africa is unimportant, for it is the only continent where relatively few mammals have hides heavy enough to be classed as "fur." This is not surprising considering that the entire country is tropical or subtropical and the higher mountains are insular in character and furnish no properly situated, cold environment suitable for the development of "fur" animals. Excluding a few showy monkeys, hyraxes, and duikers, the African mammals whose hides appear more regularly in trade channels are nearly all carnivores, mostly nocturnal in habit. So far as individual value is concerned, lions and leopards are by far the most important. Foxes, jackals, aard-wolves, genets, servals, lynxes, and other cats, civets, mongooses, zorillas, and otters are types whose skins are found less frequently in the trade. Squirrels and flying squirrels, which in Europe and Asia are so important a contingent, in Africa neither have soft enough fur nor occur in sufficient numbers to invite exploitation in this respect.

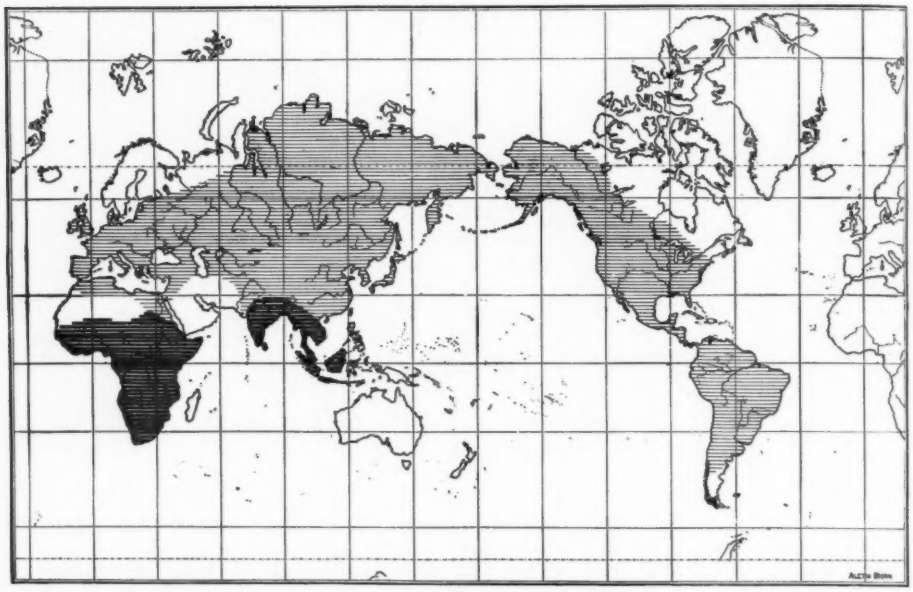
While the lion has been wiped out in all the regions north of the Sahara and south of the Orange River, it is not because the hide commands the highest price paid for that of any African carnivore. The confinement of the lion within its present restricted domain must be ascribed rather to the activities of hunters, often acting in the interests of steadily advancing civilization. The leopard, or "panther" of the fur trade, has a much wider distribution in Africa than the lion, for, unlike the latter, it inhabits forest regions as well as open country. Due to the natural shelter thus offered and also to the fact that the leopard is more cautious by nature, it has been able to hold its own in spite of the fact that thousands of pelts reach the coastal regions every year. Of course, African natives have little use for skins. Those of lions, leopards, and okapis are occasionally worn by persons of distinction, and the skins of small Felidæ and primates are used to decorate dan-

[1]Prepared by Mr. Herbert Lang of the American Museum of Natural History.

Photographed by Carl E. Akeley

IMPALLA ANTELOPES

These dainty creatures, mirrored in the still water, represent only one of the numerous species of antelopes that have proved so fascinating to the traveler in Africa



DISTRIBUTION OF ELEPHANTS AND MASTODONS

Present

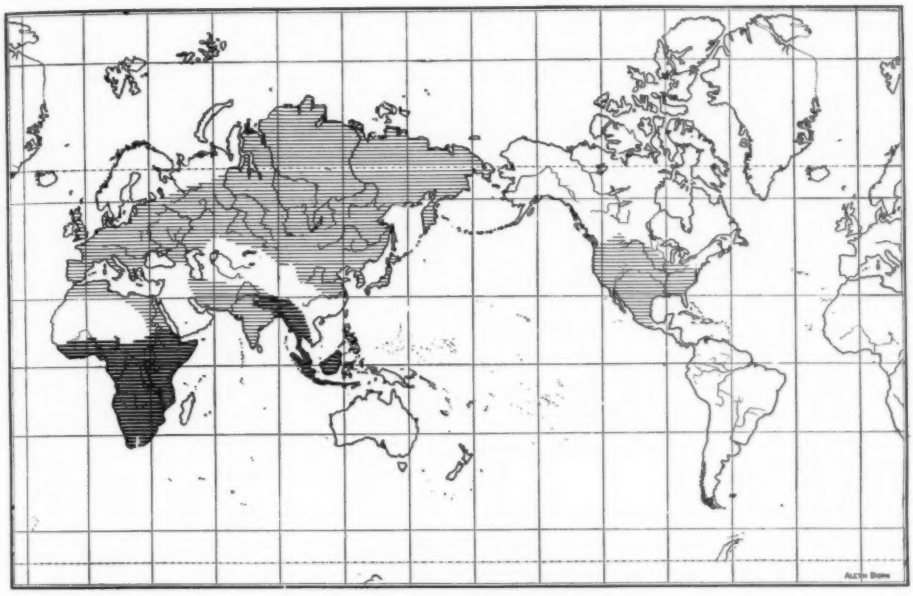
Former

In earlier geological times elephants and mastodons had a very wide range as shown by the above map

cers. In South Africa alone large rugs are made of skins, and a distinctive pattern is secured by combining the pelts of various animals, such as the jackal, genet, civet, and duiker, as well as of antelopes other than the duiker. The Masai and Kikuyu, who live in higher altitudes in East Africa, are very proud of the cloaks they wear, which consist of the skins of tree hyraxes (*Dendrohyrax*) sewed together. But on the whole, native needs in these respects are small and easily controlled. Among the primates the baboons and other forms have furnished a few pelts, but certain Abyssinian and East African *Colobus* or *Guereza* monkeys have suffered most. Their hides of glossy black, silky hair, draped on the sides with long fringes of flowing white, and terminating at the end of the tail in a magnificent white brush are coveted by natives and Europeans. In most parts the government now confiscates these skins, only two of which can be exported by any one party and then only by special permit.

Africa has been a great paradise for game animals for a century past and has naturally suffered heavily from the unavoidable destruction that attends the progress of civilization. The larger members of its fauna have been the principal victims. The numerous vast herds observed by earlier travelers in Africa, especially in the southern and eastern parts, have now dwindled to such an extent that it is doubtful whether even the protection afforded by game preserves will be able to prevent their ultimate disappearance.

Total extinction in relatively recent times has claimed only two of the larger African mammals: the quagga (*Hippotigris quagga*) and the blaubok (*Egocerus leucophæus*), both of South Africa. Undoubtedly the need for the meat, the use of the hide, the desire for sport, and wanton slaughter were the chief factors



Contrast the present restricted range of the rhinoceroses with the territory over which they roamed before the Age of Mammals passed the climax of its development

in the destruction of the quagga, a zebra striped only on head, neck, and shoulders. How suddenly the quagga and the blaubok disappeared is evident from the fact that only a dozen specimens of the former and only five of the latter are preserved in the various museums of the world. In the Aberdeen district the last quaggas were killed in 1858 but in Orange Free State a few held on till 1878; notwithstanding many rumors to the contrary, none are known to be alive now. The blaubok appears to have been scarce always, at least as far back as records go; by 1731 it seems to have been confined to the Swellendam district, in the southwestern portion of the Cape Colony, and the year 1800 probably marks its complete extinction. A close relative of the quagga, the mountain zebra (*Hippotigris zebra*), is even now on the verge of dying out. According to Haagner, one of the well-known sponsors of the movement for game protection in South Africa, the mountain zebra is now represented only by small herds aggregating about 400 head in all and restricted to the mountainous regions about Cradock, Oudtshoorn, and George.

The handsome bontebuck (*Alcephalus pygargus*), formerly widely distributed, now lingers only near Bredasdorp and Swellendam, profiting by organized protection. The blesbok (*Alcephalus albifrons*) has a more enviable record; its facility in adapting itself to a semi-domesticated mode of life has made its future more assured, for many farmers in South Africa maintain a few herds. Not to speak of really rare creatures like the forest-living okapi (*Okapia johnstoni*), which seems on the verge of natural disappearance, other game, once plentiful, is becoming alarmingly scarce. The black wildebeest (*Connochætes gnu*), the greater koodoo (*Strepsiceros strepsiceros*), and in many regions buffaloes and elands have been greatly reduced. Their local

extinction in the past has been due to the periodical occurrence of rinderpest, a disease which practically annihilated them in extensive areas. Present conditions of inadequate protection do not allow recovery through the gradual formation of new herds as in times when these animals were unmolested by sportsmen and settlers.

Of the white rhinoceros (*Ceratotherium simum simum*), once believed to be entirely extinct in South Africa, a few still enjoy a refuge in Zululand; and thriving colonies of a closely related form have been discovered in northeastern Belgian Congo and in parts of the Sudan east of the Nile. What contributed more than anything else to the gradual destruction of this animal was the market value of the horns. Superstitious peoples of far-off Asia would pay almost any price for powder made from the horns, for it is supposed to be a magic medicine.[1] Furthermore native chiefs have always vied with one another to come into possession of a horn staff of unsurpassed length. Giraffes also have been subject to ruthless destruction in Nubia and especially in South Africa, and the elephant, due to the value of ivory, is now extinct in many quarters and found in numbers only on the eastern and northeastern borders of the great equatorial rain forest.

Photographed by Kermit Roosevelt

The white rhinoceros, for all its size, strength, and ugliness, is no match for the forces of destruction which are leagued against it. Picture reproduced by permission of Charles Scribner's Sons, from *African Game Trails* by Theodore Roosevelt, copyright 1909, 1910

[1]This superstition was in earlier centuries prevalent in Europe. The reader is referred to the article by Frederic A. Lucas, entitled "The Unicorn and His Horn," NATURAL HISTORY, November–December, 1920, pp. 532–35.

VANISHING WILD LIFE OF SOUTHERN ASIA

Colonel F. C. Faunthorpe, Commissioner of Lucknow, India, and well known for his deep interest in the preservation of game in India, writes (July 16, 1922):

"If you wish to obtain a representative collection of the wild animals of the plains of India, which, set up in groups with reproductions of their natural surroundings, will form a collection of great beauty, and one which at present does not exist anywhere in the world, I would urge that there is no time to lose. Owing

Photographed by N. W. Frost

Anyone who has seen the wapiti in its native haunts must view with consternation the impending extinction of such a splendid creature

to changed conditions in India, conditions which are likely to persist, game is, in many places, decreasing to the point of extinction, and it is probable that within a short period there will be very little left, except in portions of the Government Reserved Forests (the ultimate fate of which one cannot at present predict), and in the shooting preserves of some of the Indian princes. As an instance, I may say that in the Sitapur District of my Division, in which black and gray partridges were formerly abundant, the district officer recently told me that these birds are practically extinct. In the Hardoi District of my Division, in which the Indian antelope was found in large numbers a few years ago, they are now extremely rare. In the reserved forests of the Kheri District of my Division I beat last Christmas for swamp deer. In what was the best ground for them a few years ago, we did not find a single stag where three or four years ago I should have expected to see at least twenty. . . . It is essential, therefore, that the collection should be made as soon as possible."

To meet this emergency the American Museum has recently completed arrangements with Colonel Faunthorpe and Mr. Arthur Vernay to secure for the new Asiatic hall some of these fine animals of southern Asia before they disappear.[1]

[1]To meet the criticism which may possibly be made, namely, that museums themselves are contributing to the extermination of rare mammals, we would state that the American Museum does not sanction wholesale collecting of disappearing species. It is obvious to all that a natural history museum should be a repository of the actual facts of nature, notably the skins and skeletons of animals, and should some interesting mammal disappear from the face of the earth before such a permanent concrete record of it could be prepared and stored up for posterity, museums would have indeed been derelict in their duty. It can never be stated truthfully, however, by one in possession of the facts, that the American Museum, in any of its activities, is endangering any species of mammal. Only a pair, or a pair with young, is collected when a certain species is struggling hard for existence and on two occasions recently the American Museum has refused offers to collect much needed species of mammals on the grounds that the taking of even a limited number of specimens would depress the balance too heavily.

Bighorn sheep live in the roughest and most inaccessible regions where the sight of a big old ram is certain to be remembered by the beholder

CLOSE OF THE AGE OF MAMMALS

From the standpoint of the naturalist, the AGE OF MAMMALS has long since closed as compared with the close of the AGE OF REPTILES, which occurred more than three million years ago. Extermination of the large mammals has been going on for a century; extermination of the small mammals has been extremely rapid in the last two decades. In North America alone mammals, broadly speaking, have disappeared within our life time. The present rate of destruction throughout the world from various causes, is probably not less than fifty million a year, of which thirty million represents the demands of the fur trade. The bison is extinct in the United States except for the animals preserved in parks. Through the splendid efforts of the American Bison Society this noble quadruped is now rapidly multiplying. In Canada the wood bison is still holding its own and is, perhaps, slowly increasing. The elk, or wapiti, has disappeared from the greater part of its old range and is now found in its wild condition in only a few of our western states. On the danger line of actual extinction is our beautiful pronghorn antelope, the existence of which is seriously threatened, especially because of the great difficulty in supplying it with its natural conditions of life. Our other two large mammals, the Florida manatee, a wonderful "living fossil," survives in a restricted area and in limited numbers; the splendid elephant seal of the Pacific has been completely killed off except for a small colony in Guadeloupe Island. The sea otter has been very nearly exterminated along the American coasts. The American beaver is extinct over most of its ancient range but has increased in an astonishing manner in the areas where it

is protected. Among the great mammals of the sea the California gray whale is nearly extinct. The right whale is in danger of extermination, and the disappearance of the bowhead whale is also threatened. The American Museum has thus far failed in its efforts to secure examples of this splendid species of whale before it disappears.

In many parts of the world, in Australia, in northern and southern Asia, and in North and South America, American Museum explorers are especially charged with the great mission of securing single specimens of these fast-vanishing remnants of the AGE OF MAMMALS before it is too late. Many of the specimens which the Third Asiatic Expedition has secured will be among the last of their kind to find their way to the great museums of the world, because Mr. Roy Chapman Andrews, the leader of the expedition, has observed that their numbers are limited and that they are in near danger of extinction.

BIBLIOGRAPHY

Readers of NATURAL HISTORY who desire to join forces with the nature lovers in various parts of the world in trying to save the mammals, will secure further information and inspiration from the following papers and books by such leading conservationists as Hornaday, Nelson, Hewitt, Evermann, Osborn, and others.

1904.—*Preservation of the Wild Animals of North America.* Henry Fairfield Osborn. Published by Boone and Crockett Club, pp. 1–27.

1912.—"Preservation of the World's Animal Life." Henry Fairfield Osborn. Published by *American Museum Journal*, Vol. xii, No. 4, pp. 123–24.

1913.—"The Preservation of Animal Life." Henry Fairfield Osborn. Leaflet No. 16 of American Society for the Prevention of Cruelty to Animals, August, 1913, 1 p.

1913.—*Our Vanishing Wild Life, Its Extermination and Preservation.* William T. Hornaday. Foreword by Henry Fairfield Osborn. 1st ed., 3000, published by Charles Scribner's Sons, Jan. 18, 1913; the 2d, 10,000, by the New York Zoological Society, January 18, 1913. pp. 1–411.

1914.—*Wild Life Conservation in Theory and Practice.* William T. Hornaday. Published by Yale University Press. pp. 1–240.

1915.—*The Statement of the Permanent Wild Life Protection Fund, 1913–14.* William T. Hornaday. Published by the Fund. pp. 1–97.

1917.—*The Statement of the Permanent Wild Life Protection Fund, 1915–16.* William T. Hornaday. Published by the Fund. pp. 1–219.

1919.—*Our National Elk Herds.* Henry S. Graves and E. W. Nelson. United States Department of Agriculture, Dept. Circ. 51. pp. 1–34.

1920.—*The Statement of the Permanent Wild Life Protection Fund, 1917–19.* William T. Hornaday. Published by the Fund. pp. 1–199.

1921.—*The Fur Trade of America.* Agnes C. Laut. Published by the Macmillan Company. pp. 1–341.

1921.—"Conserving Our Wild Animals and Birds." Edward A. Goldman. Yearbook Department of Agriculture, 1920. pp. 159–174.

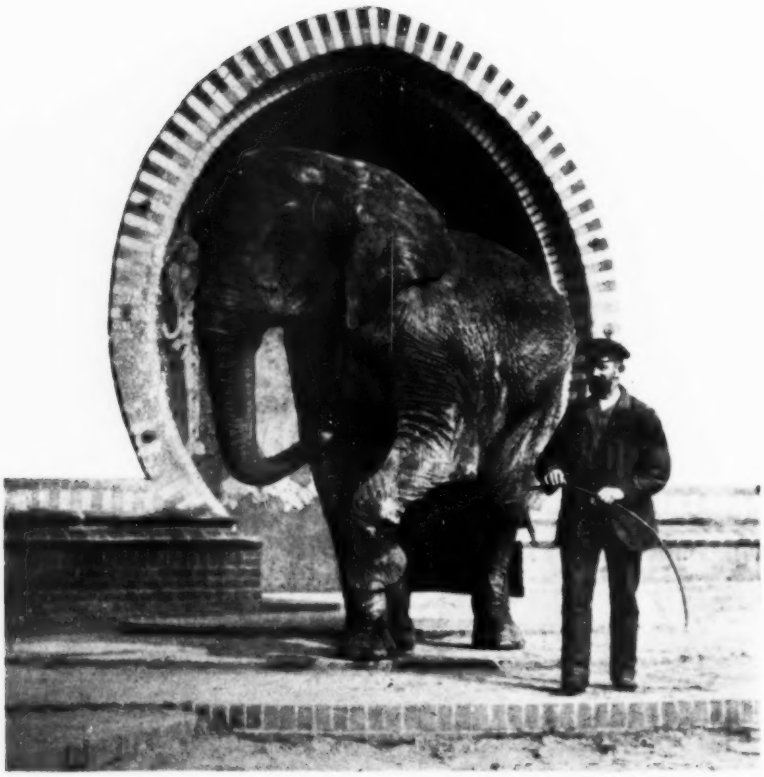
1921.—"The Fur Trade and the Wild Animals." William T. Hornaday. Zoological Society Bulletin, March, 1921.

1921.—*The Conservation of the Wild Life of Canada.* C. Gordon Hewitt. Published by Charles Scribner's Sons, 1921. pp. i-xx, 1–344.

1921.—"The Big Game of Alaska." E. W. Nelson. Bulletin American Game Protective Association, April 1, 1921. pp. 1–7.

1922.—"The Fur Trade and the Fur Supply." G. T. Ashbrook. *Journal of Mammalogy*, February, 1922, pp. 1–7.

1922.—"The Conservation of the Mammals and other Vanishing Animals of the Pacific." Barton Warren Evermann. *Scientific Monthly*, March, 1922, pp. 261–67.



Courtesy of Mr. Herbert Lang

As the elephant walks along beside its keeper, it lowers its pillar-like legs deliberately as though conscious of the crushing force of their descending weight. Although the author has walked around the circus ring for hours with elephants in order to exercise them, he does not recall that one ever came in contact with his foot, and such an experience would indeed be unforgettable. The present picture was taken in the Berlin Zoölogical Park

THE ELEPHANT IN CAPTIVITY

BY

W. HENRY SHEAK

THE elephants are a dying race. In the Pleistocene, and I may say Post-Pleistocene, these giant mammals were the dominant form of animal life. There were many species and, judging from the many fossils found, multitudes of individuals. Charles F. Holder in his thoughtful book, *The Ivory King*, expresses the conviction that the elephant could not have been extinct in Alaska more than five hundred years at the coming of Columbus. The order was clearly divided into two well-defined groups in those early days, mastodons and mammoths, the distinction being based primarily on the structure of the crowns of the molar teeth. These animals had a wide geographical distribution, being spread over all the grand divisions of the earth exclusive of Australia.

Numerous well-defined species have disappeared in recent geological times, leaving only their huge skeletons in the peat bogs and alluvial deposits to remind us of the days when they browsed on the overhanging foliage or thundered through the forest primeval, pursued by savage man with his stone spears and

sling shots. A few mammoths only left their entire carcasses, including hide, hair, and stomach contents, frozen in the ice and gravels of Siberia. Of the many forms living so recently, only two, the Indian and the African elephants, survive.

Just how much use Palæolithic man or Neolithic man made of the elephant, we do not know. We find the form of the mammoth drawn and painted on the rock walls of the old caves of Europe, and even carved on a piece of his own tusk. We find his bones among the débris on the floor of these caves, or in the kitchen middens near their mouths, buried with the remains of the reindeer, bison, wolf, cave bear, horse, dog, and man himself. The ivory was carved into objects of use and ornament. It cannot be doubted that primitive man used the flesh of the mammoth for food. It is probable also that he devoted the hide and hair, and possibly the bones, to various purposes. But there is no evidence that early European man ever domesticated the mammoth.

The beginning of domestication of the elephant, like that of other domestic animals, is shrouded in obscurity. When it began, no man knows. But unlike the case of most domesticated animals, the original wild stock of the elephant still persists. Indeed, this great quadruped is not only such a slow breeder, but such an infrequent breeder in captivity, even in its own native climate, that practically all elephants in zoölogical gardens, in traveling menageries, and in domestication even in India, Burma, and Siam, have been obtained from the wild herds of the forest and jungle, and tamed.

Not a few baby elephants, reports say, have been born of adults with traveling menageries in this country. Most of these reports are fabrications. But I know of two well-authenticated births occurring here; in neither case was the mother pregnant when imported. The first of these was in Philadelphia, at the winter quarters of the old Bailey, Scott, and Hutchinson show, in 1880. P. T. Barnum came to Philadelphia to see the baby and offered the owners a goodly sum for this feature attraction, but they only laughed at him. However, Mr. Barnum was not a man to be turned from his purpose and he proposed that the two shows be united. This suggestion proved acceptable and was the beginning of the Barnum and Bailey circus. The baby was named Columbia and lived for many years in the circus menagerie. Although her mother, Hebe, commonly known about the show as Babe, was one of the best-natured elephants I ever knew, the daughter grew meaner and meaner as she got older, until in 1905 or 1906 she had to be killed. Mr. Bates, who was assistant superintendent of elephants for a long period of years, told me she inherited her vicious disposition from her sire. The other baby was born at the Barnum and Bailey winter quarters at Bridgeport, Connecticut, in 1882. He was named Bridgeport and was burned up in the fire in 1887 that destroyed much of the splendid menagerie of Barnum and Bailey.

It is doubtful whether any elephant other than the Indian has been domesticated. The elephants that Hannibal brought against Rome may have been the African. Unfortunately no drawing or other picture has been found to throw light on the subject. From what we know of the African elephant of today, however, it seems extremely doubtful if this species could be sufficiently subjugated to be of any use in warfare. And if Pyrrhus, King of Epirus, could bring Indian elephants to Greece, why could not Hannibal bring them to Carthage?

Twenty years ago the old Forepaugh-Sells show carried two African elephants, a male and a female. They were both of low intelligence and vicious disposition. Frequently the keepers had to hitch an Indian elephant to one of the African elephants to pull it on or off the train. They always had to be kept heavily chained. In our herd of thirty

elephants, when I was with the Ringling menagerie in 1906, was one female African elephant. She was not vicious but a veritable "dumb-head."

I think the tallest elephant I have ever seen alive is the big African now in the New York Zoological Park. He is 9 feet, $3\frac{1}{4}$ inches tall, and is estimated to weigh 6000 pounds. He is vicious and cannot be handled. He has worn off his tusks back beyond the lips by fighting the bars of his enclosure. One needs only to look at the rounded forehead and much smaller brain case of the African elephant to expect less intelligence from him than from his Asiatic cousin.

Photographed by Elwin R. Sanborn, New York Zoological Society

The large African elephant at the New York Zoological Park.—This animal is more than 9 feet in height. The aggregate weight of from thirty-five to forty men of average build would be required to offset the total of 6000 pounds which, it is estimated, this elephant would register if placed on the scales

There are few if any animals of such strength and intelligence as the Indian elephant that can be subjugated and tamed to the same degree and in so short a time as this great proboscidian. Practically every elephant in captivity was at first a wild animal, born of wild parents, and reared in the forest. When he is first captured, he is a demon incarnate. But the elephant is a philosopher and when he learns it is useless to fight against his fate, he gives up the contest and straightway decides to make the best of the situation. Most elephants are broken and are safe to handle inside of six weeks.

The brain of the Indian elephant is two and one half times the size of that of man. It is also richly convoluted. In captivity this elephant manifests remarkable intelligence. The dog has acquired much of his sagacity from his long association with man. The elephant has not had the advantage of

countless generations of development in human society. Yet what other animal could learn in a few days his place in a big tent and be depended upon to go there and stay there, when told to do so, as is commonly the case with circus elephants? I have known one to stand by his own particular stake for a considerable time without being chained fast.

I once had an experience at Ashland, Kentucky, with the old John Robinson circus, which made me wonder if it is not rather because an elephant does not wish to leave his place than because he is not clever enough to free himself, that we find him standing patiently in one spot fastened only by a chain thrown around a stake. I came into the menagerie a short time after the parade and found Tillie, the largest member of the herd, at a considerable distance from her place, quietly feeding on the rich, succulent grass with which the lot was covered. She very readily went back with me and I took a half-hitch about the stake. In less than five minutes I saw she was loose again. Thinking I had not fastened her securely, I brought her back and this time took extra care in chaining her. I then went out to lunch. When I returned, she was once more grazing. As I was bringing her back for the third time, the superintendent of the menagerie came in and said: "You might as well let her go; she wants to eat grass and will not do any harm. When the people are in, she'll stay in her place." I then watched her. She took hold of her chain, but did not pull a steady pull, instead shaking and wriggling until she had lifted it up off the stake.

Like most animals, elephants are fond of rubbing against a tree, pole, or other object. But for such great beasts to rub against the menagerie center poles means disarranged lamps or even more serious damage. So they are commanded to stand by the poles and yet not to touch them. The latter part of the command is, of course, sometimes forgotten, and yet one is often obliged to marvel at their almost perfect memory and obedience. The following incident illustrates the intelligence and keen comprehension of this interesting mammal.

One evening in the South I was pacing up and down in front of the Robinson herd. The night was cold and I was trying to keep warm. Tom, a small bull with very long tusks, began rubbing against a center pole. The lamps at once commenced to swing as in a crazy dance. I shouted, "Tom, that pole!" He started to get away, but he was very slow and deliberate in all his movements, especially in doing things you asked him to do. Queen, a big cow who stood by him, put her head against his flank and gave him a push that landed him well away from the pole. She was not very obedient herself, but she knew what I wanted him to do and saw that he did it.

We fed the herd a mash of bran and oats once or twice a day, placing a pile of this food between each pair of elephants. Tillie and Queen, the two largest members of the herd, stood together. Almost invariably Tillie would divide the pile, quite equally and fairly, pulling her share over closer to her. But when Queen was looking the other way, she did not scruple to reach over and take a handful (or trunkful) off Queen's pile.

Most of the elephants with the Robinson circus were trained animals and I have seen them in the winter quarters at Terrace Park, Ohio, going through their acts without any human assistance, apparently for the mere pleasure of the exercise or to relieve the monotony of life in the building. The elephant house was built against a low hill; the windows on that side were high in the wall. I have seen them get up on their hind feet to look out of these windows.

As with many forest-loving animals the eyes of the elephant are not good for long range. But the senses of smell and of hearing are very keen. I was in the elephant house at the Wallace winter quarters at Peru, Indiana, one winter

ENLISTED AS A STREET CLEANER

During a heavy snowfall some years ago in Bridgeport, Connecticut, elephants of the Barnum and Bailey Circus were harnessed to snow plows. They not only performed an important civic duty but gave the children of the community many delightful free rides

afternoon. The herd was feeding on corn fodder, making a loud, rustling sound as they handled the stalks and dry leaves. Presently there was some strange noise outside, not loud but peculiar and unusual. Instantly the rustling ceased. Every one of the great beasts was standing perfectly still, the great ears thrown out, listening. For fully a minute absolute silence reigned. Then, as the sound was not repeated, they went back to their fodder.

The rhythmic, pendulum-like swinging from side to side, so common with elephants in captivity, I have always considered an effort to relieve the monotony of standing in one spot for long periods of time and to obtain some exercise. I do not remember ever to have seen an elephant indulge in this practice when he was not chained fast. It is a common belief that in throwing dirt over his back the elephant is trying to protect the sensitive parts of the skin from the bites of insects. But elephants do this in winter, when insects are rarely in evidence, as well as in summer. I am inclined to think the practice was begun as a protection against insects, but has been kept up for so many generations that it has become a fixed habit and is indulged in, almost unconsciously, at all seasons. Then, too, it may be a sort of dust bath, the dirt having a cooling or soothing effect on the skin.

To illustrate the reasoning power of the elephant, *Chambers' Encyclopedia* relates the following incident. A tame elephant in India chanced to fall into a pit. There were some billets of wood and old lumber scattered over the bottom of the pit. He gathered these together and made a pile of them. Then mounting upon the pile he was able to make his escape.

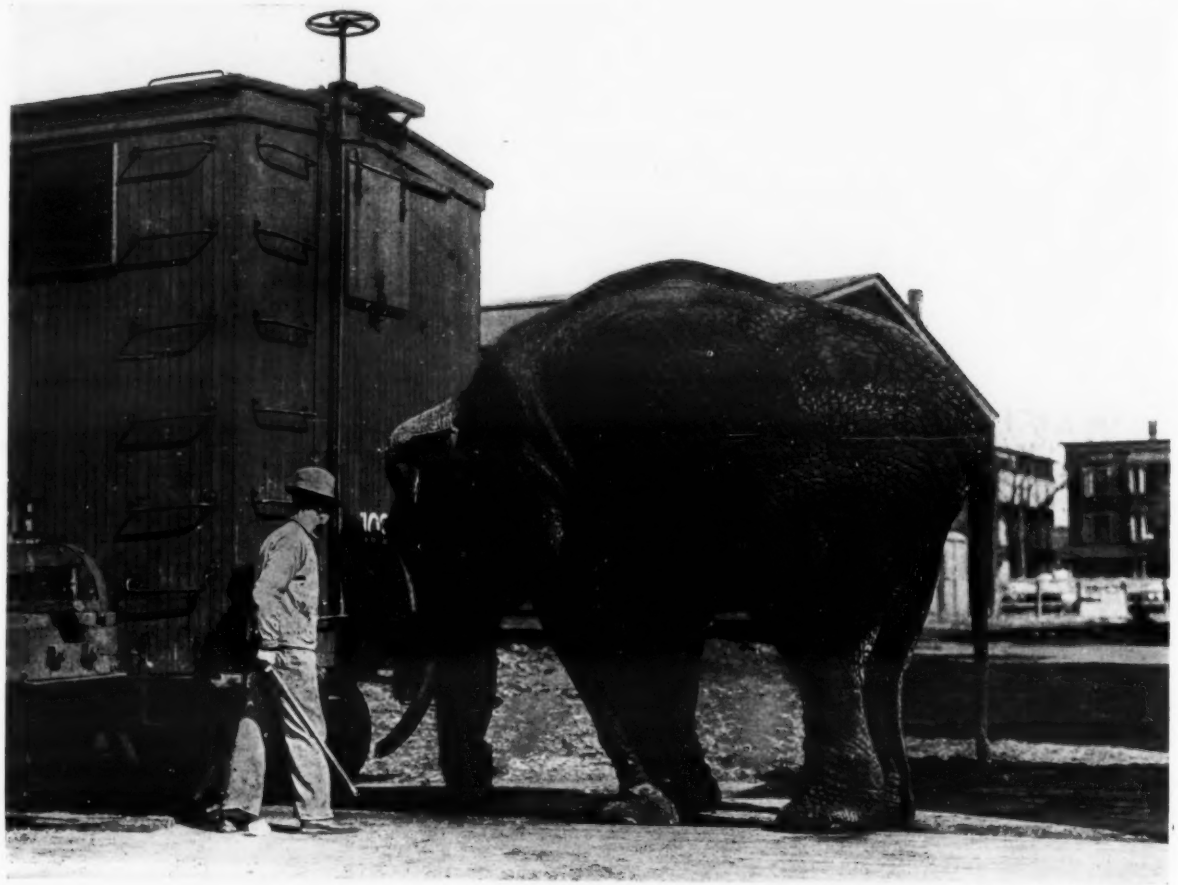
Several years ago, when Dunk was still living, I visited the elephant house in the National Zoological Park. The floor of Dunk's enclosure was raised several inches above that of the front of the building. A peanut lay at the base of this raised floor and Dunk was trying to obtain it. But it was too close to the raised floor and he could not get hold of it. After a little he put his trunk down near the peanut and blew a gentle blast, rolling it out where it was easily accessible.

Dunk was the only elephant I ever knew who, having "gone bad" in a traveling menagerie, regained his good disposition in a park. Usually when an elephant "goes bad," he is bad ever afterward. Bolivar, of the Philadelphia garden, and Chief, of the Cincinnati garden, are conspicuous examples. Chief became more and more wicked after he entered the garden, until he had to be put to death.

When I was with the Ringling menagerie, we had a large female that we used as a pushing elephant. One morning the assistant superintendent used her to push a heavy wagon across a soft lot. But the harder she pushed, the deeper the wheels went into the sand. She stepped back, her little beadlike eyes on the heavy vehicle, and seemed to be meditating upon the problem. Then she reached down with her trunk, took hold of one of the wheels, and gave a strong lift, at the same time pushing forward with her head; the wagon moved out of the rut.

The passions of fear, hatred, jealousy, and love are all keenly developed in the elephant. Although he is brave to face any danger he understands, no animal so quickly takes to flight at some unusual sight or sound. At Morrelton, Arkansas, I was riding in the howdah on Tillie in the street parade. The lot where our encampment was located was about a mile from the town and the road to it followed the railway, the latter being elevated on an embankment about ten feet above the public thoroughfare. A crowd of people climbed to the railroad to look down on the parade as we went back. As usual, the elephants were bringing up the rear. We had got about half way back to the lot when an engine

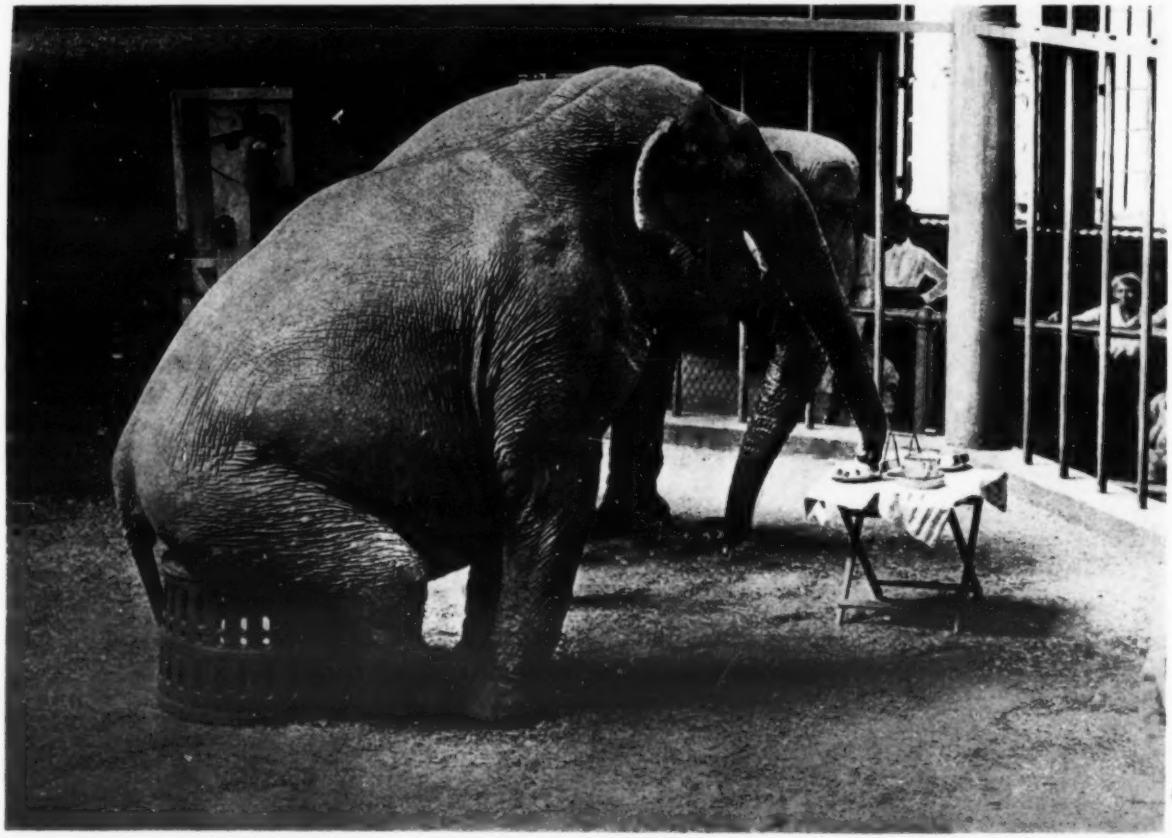
During a heavy snowfall some years ago in Bridgeport, Connecticut, elephants of the Barnum and Bailey Circus were harnessed to snow plows. They not only performed an important civic duty but gave the children of the community many delightful free rides



Copyright, Underwood & Underwood

A SUBSTITUTE FOR A LOCOMOTIVE

In India, Burma, and Siam, as is well known, the elephant is used in logging operations, proving a tractable and intelligent co-worker with man. The employment of this animal on the railways of our country is a practice that strikes one as bizarre and manifestly it is a practice that can never become general. Nevertheless, it suggests one of the uses to which this adaptable animal may be put in emergencies, and indeed pushing-elephants are of service to circuses under all conditions. With his head lowered, his weight thrown forward, his whole attitude intent upon the task in hand, this heavy jungle creature is about to match his strength against a resistant freight car. That the freight car will yield before him there can be little doubt, for when the elephant exerts his strength, even brick walls yield to his pressure. In a combat that occurred thirty years ago between two elephants housed in the Wallace winter quarters, one pushed the other through a solid brick wall fourteen inches thick



AFTERNOON TEA

As a pet the elephant is rather unwieldy and yet in spite of his potential strength and his air of gravity, he will perform stunts as docilely as a house dog bent on pleasing his master. Usually it is only in the circus ring that these massive quadrupeds are put through their repertoire of tricks, but occasionally inmates of zoölogical gardens offer entertainment of this character. An example is the afternoon tea party depicted here, representing a scene enacted at the Franklin Park Zoo in Boston.

Sometimes elephants that have "gone bad" in travelling shows are consigned to zoölogical gardens or parks. Though in their general disposition resembling the little girl who "when she was good, was very, very good," the elephant when he has once "gone bad" is apt to grow steadily more horrid. When the temper of such an elephant reaches the danger point, it becomes necessary to kill him

approaching from behind began whistling as a signal for the people to get off the track. This threw the elephants into a panic and they started to run. One of the circus girls who was riding in the howdah with me jumped and screamed to me to do likewise. But I knew the safest place for me was on the back of that elephant, provided I could stay there. So I held on to the howdah with might and main. We soon quieted the elephants with soothing words and they stopped their mad flight. The race did not last long, but it was interesting while it did last.

When an elephant is badly scared, he becomes panic stricken and takes complete leave of his senses. Then he is likely to run over you, trample on you, or crush you against something. It was in this way that Lockhart, the famous trainer, was killed. He was loading one Sunday morning in London, when something frightened the herd. The elephants started to run through the railroad yards and Lockhart after them. A big bull, in mad terror, crushed him against the side of a car. But the elephant is ordinarily a very careful animal, and when not frenzied by fear, never hurts a man accidentally. I have walked around a circus ring for hours with elephants, giving them exercise, but do not remember that one of them ever touched my foot with his foot. But when a horse was put into the ring to accustom him to walk with elephants, the horse and I began at once to tread on each other's feet.

We once had a large female elephant that did an act with a very small pony. At one stage of the act the little pony would lie down in the ring and let the big pachyderm step over him. She was very much attached to the pony and was so afraid she might step on him that her extreme caution became humorous. She moved her feet so slowly that the trainer had to jab her with the hook to hurry her up a little.

The likes and dislikes of the elephant are very pronounced and these create some of the hardest problems elephant men have to solve. With the Robinson show we had a small female known as Queenie. Tillie, the star performer of the herd, was very much attached to Queenie, and if the latter made any noise while the elephant act was in progress, Tillie would break away and race back to the menagerie, with the whole herd at her heels. At Cumminsville, a suburb of Cincinnati, we had such a stampede, and the people lost their heads and rushed down on to the hippodrome track. The whole herd went through the crowd on the double quick without hurting a single individual, illustrating the exceeding carefulness of this, the largest of the world's land mammals. Some big strong man with a tent stake always had to be set to guard Queenie and make all sorts of dire threats as to what he would do to her if she dared open her mouth.

The elephant often becomes affectionately attached to his keeper and will fight for him. Tillie formed a close attachment for a nine-year-old girl belonging to one of the circus troupes. Every evening the child came into the menagerie, and the big beast would fold her trunk gently about her, fondle her, and express in many ways her liking. If any one approached the little girl, Tillie would step back and throw out her ears in a threatening attitude.

No animal is quicker to resent an injury or insult, or supposed insult. Charles Alderfer, now manager of the Alderfer Circus, began his life as a showman with the elephants of the Wallace menagerie. One day in winter quarters the head painter wanted some wagons moved and Alderfer volunteered to bring out an elephant. He brought out Pilate, notoriously surly in disposition. In backing one of the wagons, the pole, or tongue, struck Pilate on the side. He thought it was Alderfer's fault and started for him, his ears spread out like the sails of a yacht. The painter said for a few minutes he would not have

given fifteen cents for Alderfer's life. The latter ran at top speed and jumped over a fence. Then he put the hook into Pilate, climbed back, led him to the elephant house, chained him up, and whipped him severely. Pilate apparently recognized the injustice of his suspicion for after that he was always the friend of Alderfer.

No animal hates more intensely, or avenges himself more cruelly on his enemy, be that enemy human or of his own species. In October, 1892, there was an exciting elephant fight at the Wallace winter quarters. It occurred on Sunday evening. The show had been in from the road only a few days. There were five elephants in the herd, four of them big bulls. After an early supper, the keepers left their charges, each chained to the floor by the left foreleg, and went to town. In some unaccountable way, four of the five elephants got loose. Pilate and Diamond had always had an antipathy for each other and at once began fighting. Their trumpeting made the night hideous. The lions and tigers in a near-by building added their roaring and screaming to the awful chorus, and the neighbors for miles around thought bedlam had been turned loose. The two vicious brutes fought savagely until Pilate had one of his tusks broken, whereupon Diamond put his head against his antagonist's side and pushed him clear through the outer wall of the building, a solid brick wall fourteen inches thick. They had gored each other until the building looked as if a river of blood had flowed through it. But, strange to relate, neither of them was seriously hurt and in a few days, barring Pilate's broken tusk, they appeared to be in as good condition as ever.

Courtesy of Mr. Herbert Lang

AN ADULT PELICAN SHADING HER NEWLY HATCHED YOUNG

Shade is a rare luxury on Bird Island, and while the nestlings are still very young and in a more or less naked condition, the parent bird spends much of the time shielding the little ones from the intense rays of the sun

BROWN PELICANS AT HOME

A VISIT TO BIRD ISLAND OFF THE COAST OF TEXAS

BY

ALVIN R. CAHN

ABOUT thirty miles south of Corpus Christi, Texas, there lies a tiny, crushed-shell island, some six miles off the coast. This wee speck of land, less than half a mile in length and a couple of hundred yards in width, rises out of the Laguna Madre, a long, narrow strip of water separated from the Gulf of Mexico by the equally long, sandy Padre Island, which plays the part of stolid protector with more or less success. True, Bird Island, as this spot of shell reef is known locally, is protected from the fury of the Gulf by the sand dunes of Padre, but even these fail in times of excessive impetuosity to stem the attack of the waters of the Gulf. At such times the waves rise in their fury, overwhelm Padre Island, and Bird Island and its unfortunate inhabitants are buried beneath twenty feet or more of wind-lashed ocean. Luckily, such catastrophes are infrequent, yet such a calamity occurred in the fall of 1919, in the big storm which caused such havoc at Corpus Christi.

It was with some doubt in my mind, therefore, that I made the journey to Corpus, *en route* to Bird Island, to see what I could see. To the inquiries I made in the city I received the answer that birds were nesting on the island, though certainly not in the numbers that had existed there previous to the big storm. The local game warden was sought, and his knowledge solicited. Yes, there was a Bird Island, though how large it was or what was on it he had not the slightest idea. Had he never been there? No, never; he had never had occasion to visit it. The germ of doubt, already in my mind, grew, but the timely discovery of the owner of a launch, a man who knew the island, brought the sun through the gathering clouds, and after hasty preparations, early on the morning of May 26, 1921, our little party of three placed its scanty equipment in the launch and, with the boatman accompanying us, headed for the isle of birds.

Down the water lane between Padre Island and the mainland we chugged. Ward herons flapped lazily overhead, carrying food to their nestlings, or stood watching us in motionless silence, "knee"-deep in the shallow lagoon. Schools of mullet, disturbed by the passing of the boat, broke water in a thousand little ripples, and just beyond the bow of the launch raced an undulating porpoise,—his great black back, rising and sinking in the water, suggestive of a gigantic chest breathing heavily. It was altogether enchanting, but the big question on my mind kept me uneasy: were the pelicans really breeding on Bird Island? I had never seen even a single wild pelican, and I had taken this trip in order to make the acquaintance of these birds, to interview them, and to bring my results back with me on the two hundred odd photographic films I was so carefully protecting from the dancing spray and the merciless sun.

Were the pelicans on Bird Island? My hopes rose when about noon three of the great brown birds flapped slowly by, going in a direction opposite to ours: flap, flap, flap, glide; then flap, flap, flap, glide again, skimming just above the water in single file, for all the world like three "youngsters" playing at "follow the leader." Shortly a group of seven filed soberly by, and then other little squads, all in single file, all with a flap, flap, glide, and all very sedate in flight. Bird Island was easily discernible now, though it looked infinitely far off on the horizon. I could see the trees, green against the spotless sky, and the glistening white beach extending to the water, all distorted by shimmering heat waves.

Overhead laughing gulls were screaming, and reddish egrets and Louisiana herons were winging to and from the main land. Now and then a pelican emerged from the direction of the island and went sedately about its business without as much as a glance at us. A pair of Mexican cormorants appeared quite suddenly, were visible for an instant just ahead of us, then dove quickly, and were not seen again. A vague murmuring was in my ears, a low whispering that was only half audible—an impression rather than a sound.

Then the engine stopped and a voice from the stern sang out: "All out for Bird Island." With a start I came out of my enchantment. From my position —flat on my stomach on the bow of the launch—Bird Island was still on the horizon, a shimmering phantom. I sat up to see what the joke was, and lo! there was the island, not a quarter of a mile away! The beach? Yes, it was true enough. But the trees? Not a sign of anything that stood any higher than a little clump of sunflowers was discernible. Bird Island rose less than a foot out of the sea! Over the side of the boat we went, waist-deep into the refreshing coolness of the water. The equipment was loaded into the rowboat we had towed for the purpose, because the laguna was so shallow that we could land at the island only in a small boat. Two great cans of drinking water, our rations, charcoal burner, blankets, cameras, and the one little tent that was to protect the food and photographic material from the inevitable sun and the possible showers,—all were shifted into the little rowboat, and we were ready to go ashore. Then it was that I persuaded the boatman, though with difficulty, that I was indeed serious when I said I wanted him to come back and call for us on the *sixth* day. Unheard of! No one spent more than one night on Bird Island. I suspect he thought us entirely out of our minds to propose spending six whole days and nights on that treeless, shelterless, uninhabited (from his point of view), sun-baked reef. And it was with the guess that we would be mighty glad to see him when he *did* come—a guess that was wholly wrong—that he started the engine again, and turned the nose of the little launch back toward Corpus. Bird Island was ours.

The dull murmur that I had heard grew louder as we waded slowly shoreward, and became distinguishable as the voices of a myriad birds—a great singing and cackling, like that of a huge, well-stocked poultry farm. Louder and louder it grew. Laughing gulls were circling over our heads in constantly increasing numbers, darting at us, shrieking and scolding at a great rate. Then, with the grounding of the boat on the beach and the appearance of three dripping figures emerging from the sea, pandemonium broke forth in earnest, as wave after wave of gulls rose from their nests and circled, screaming, over the island.

During the days that followed—cloudless, blistering days—I studied the life on the little island and photographed its various inhabitants. Ward herons, reddish egrets, Louisiana herons, royal terns, laughing gulls, black skimmers, and many other interesting species gradually became accustomed to our wanderings, and the disturbance caused by our coming and going became less and less as the days sped on. But the birds I had come to interview were the brown pelicans, and I found them nesting safely on the far end of the island, isolated from all the other species of birds except an occasional egret or heron that ventured to nest at the outskirts of the pelican village.

I think it would have been impossible to have visited the island at a more opportune time. Nests in every stage of development were there—from those containing a single, fresh egg to those that had already been deserted by the successfully hatched young. The whole story of the pelican's breeding habits lay before me, recorded in hundreds of

nests. As seen from the distance, the pelican rookery had the appearance of the ground in early spring, covered with the last remnants of a spring thaw—patches of snow here and there, which proved in reality to be great flocks of young pelicans in their white, downy plumage. Great, heavy-winged birds flapped overhead, turning their awkward heads from side to side as they eyed first with one eye and then with the other

A young pelican just out of the egg

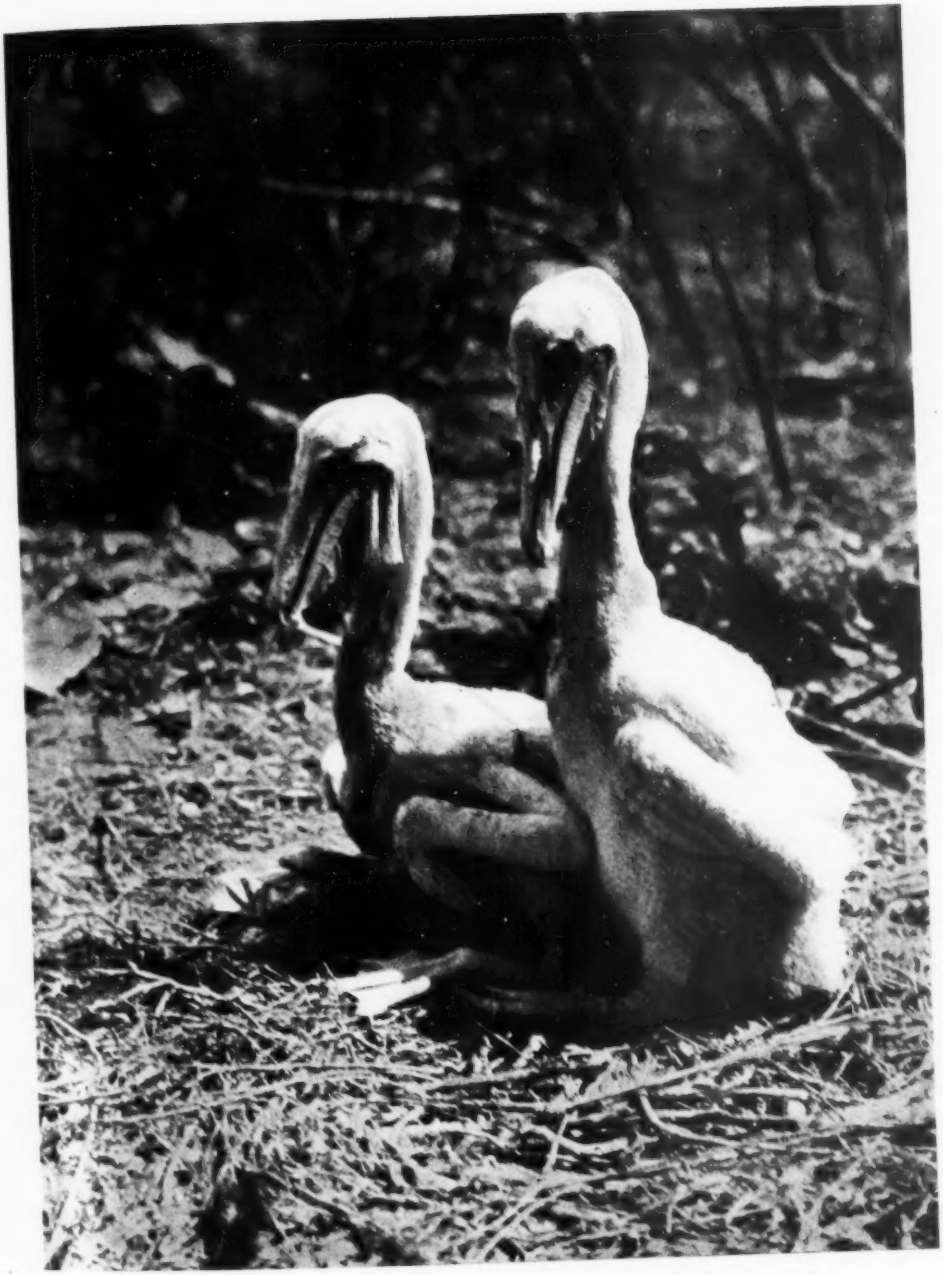
the impudent invaders of their solitude. The only sound they made was the swish of their strong wings. Several times they circled over the source of the disturbance: then, if all appeared safe, they returned to their nests; if in doubt, they dropped into the water and philosophically preened their feathers with their huge bills, apparently quite unconcerned.

The pelican nest consists of a great mass of sticks, twigs, seaweed, and other matter, with a large depression in the top to hold the eggs. This depression is usually unlined, but some nests were found which had some dry seaweed placed as a lining to protect the eggs and young. The pelican egg is very hard and thick-shelled, with a heavy, chalky surface of dull white. The average number of eggs to a nest was, according to my observation, three, and these settings were found in all stages of incubation. In one nest lay eggs that were perfectly fresh; three feet away in a neighboring nest a newly hatched pelican was just extricating itself from the confining limits of the shell for which it had no further use, while back and forth between the two nests wandered fledglings already showing the appearance of the black primaries in their wings. Here was luck indeed! In an hour I might photograph almost every stage in the adolescent period of the pelican's life.

The young pelican, on emerging from the egg, is certainly a homely little creature: black-skinned, absolutely naked, with a great head, heavy bill, and large, bulging eyes, a pelican baby is about as grotesque a creature as the imagination can draw. Entirely helpless, its head too heavy to be raised for more than a trembling second, this baby is

Whole fish are sometimes deposited in the nest for the young birds to pick at. Fish is the natural diet of the pelican from the nestling stage through adult life

Soft, white down appears, and soon covers the naked bodies of the young birds



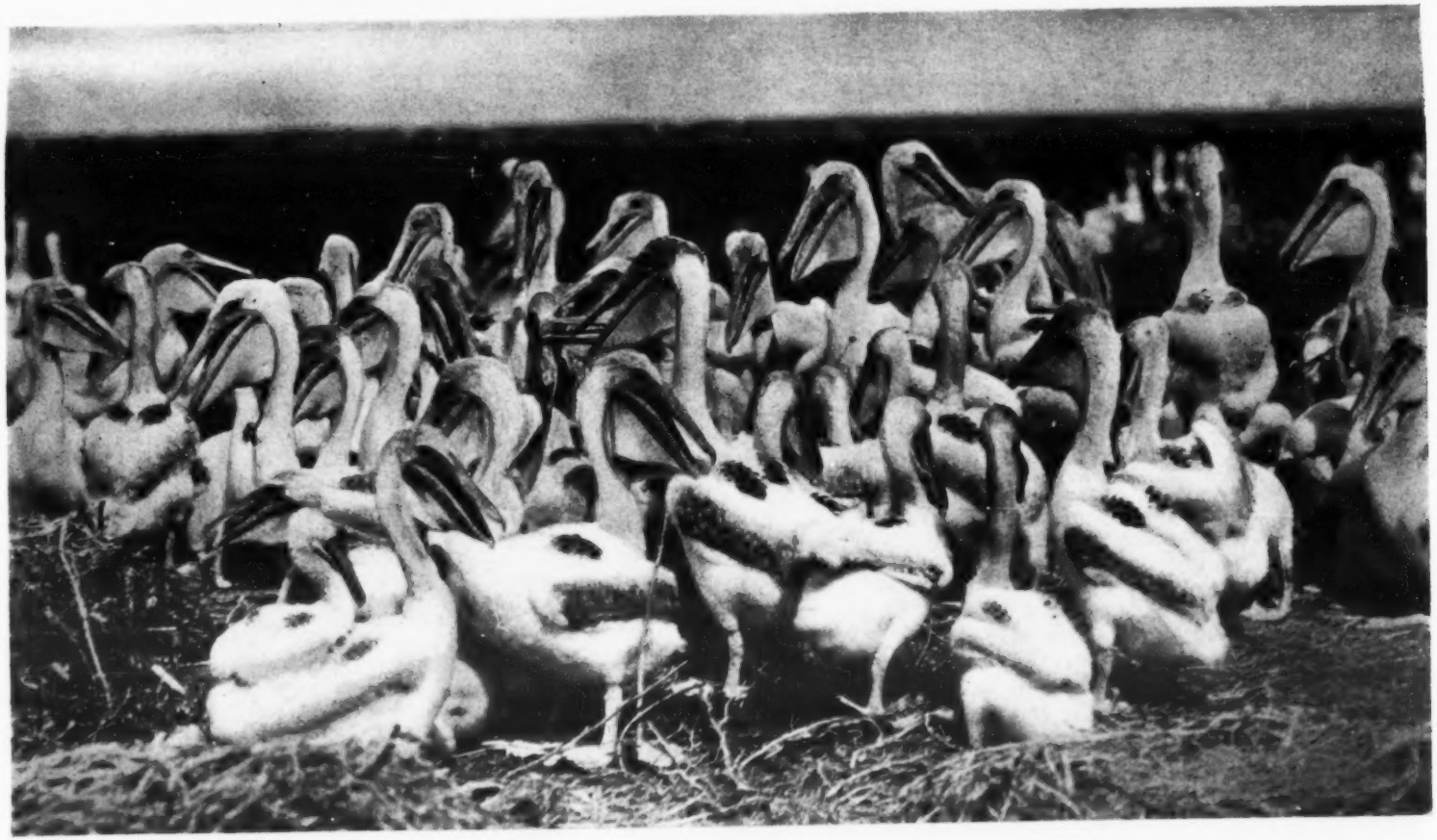
THE YOUNG ARE VERY AWKWARD, AND CERTAINLY NOT PRETTY

GATHERED FOR THE BANQUET

On her return from a fishing trip an adult pelican is almost mobbed by hungry youngsters

GATHERED FOR THE BANQUET

On her return from a fishing trip an adult pelican is almost mobbed by hungry youngsters



A COMPACT GROUP OF YOUNG BIRDS

As soon as they are able, the young birds wander about, but at first they return to the nest periodically to be fed

THE YOUNG FEEDING FROM THE POUCH OF THE OLD BIRD

THE OLD BIRD ABOUT TO SPRING INTO THE AIR

indeed a sight to call forth pity. Incubation is lax among the pelicans on the island; the May sun is so hot that the old birds can leave the nest for long periods without danger of the eggs being chilled. This laxity is, however, often fatal to the babies, for if they are unfortunate enough to choose a time when their parents are absent to emerge into this great world of ours, they are more than likely to die of sunstroke before their parents return. But the death of the babies does not seem to worry the old birds in the least. The pelican is evidently a fatalist and takes life very philosophically—worries about nothing, apparently, never gets excited, makes the best of what is, and never for an instant forsakes its dignity. One can not help wondering what a pelican thinks about.

As they grow, the young become more homely still, if such a thing be possible, but the appearance over the body of little tufts of white down eventually improves their looks somewhat. The great meals of regurgitated fish which the young bird obtains by inserting its little head deep into its parent's throat, result in a growth that is surprisingly rapid. Fish is the natural diet of these birds; it is about all they eat during their lifetime. Perhaps that is why they appear so thoughtful! About the time they are completely covered with down they are able to sit erect, and with their funny little wings pressed close to their plump little bodies they look for all the world as if they were doing their regulation calisthenics,—their "setting-up" exercises. Their legs are still too weak to hold the weight of their bodies, and they sit on their "heels," usually in contact with one another, which helps somewhat to support them. As soon as their legs will hold them, they have a tendency to "go on explores," flopping over the side of the nest and starting for a walk. These early walks are most comical. The youngster staggers doggedly along, falls over everything, tangles itself up in every stick and vine, and has a terrible time generally. However, when it has had enough, it returns to its nest and climbs back in again, using legs, wings, and beak in making the ascent. As the birds get older and stronger, their wanderings are of longer duration, and they return to the nest less frequently, eventually joining the large wandering colonies of youngsters that have already outgrown the nest. These great groups of young pelicans simply stray aimlessly about in a very limited space and wait to be fed. The only sound they make is a hissing one, with which they hope—evidently with not too much confidence of success—to frighten you away. When an old bird returns from a fishing expedition, it is mobbed by a wild mass of hungry young, each one of which is eager to get down into the pouch first. How the old bird defends itself against the attack! Crack goes the bill as it hits the nearest youngster over the head. Then crack and crack again as the dazed babies stagger away. There is no disposition to underestimate the blows: they are well aimed and heavily delivered. And if a baby is too persistent in its efforts to get the food, a sad case of cannibalism is likely to follow. Yet out of this mass of babies one is eventually fed, and who can say whether or not it is the adult bird's own offspring. To our eyes the babies all look alike. Still, the instincts of parents are beyond understanding!

When not out fishing or drifting on the water, the old birds spend much of their time "just standin' round," doing nothing. Occasionally they play with their feathers, straightening them out and preening them. Occasionally, too, one stretches its great neck upward and performs the strangest yawn imaginable. When a wandering baby comes too close, the old bird becomes irritable and whacks it viciously with its bill, so that the youngsters are constantly "running the gauntlet." Upon leaving the nest the pelican rises to a standing position, spreads its great wings, crouches, and

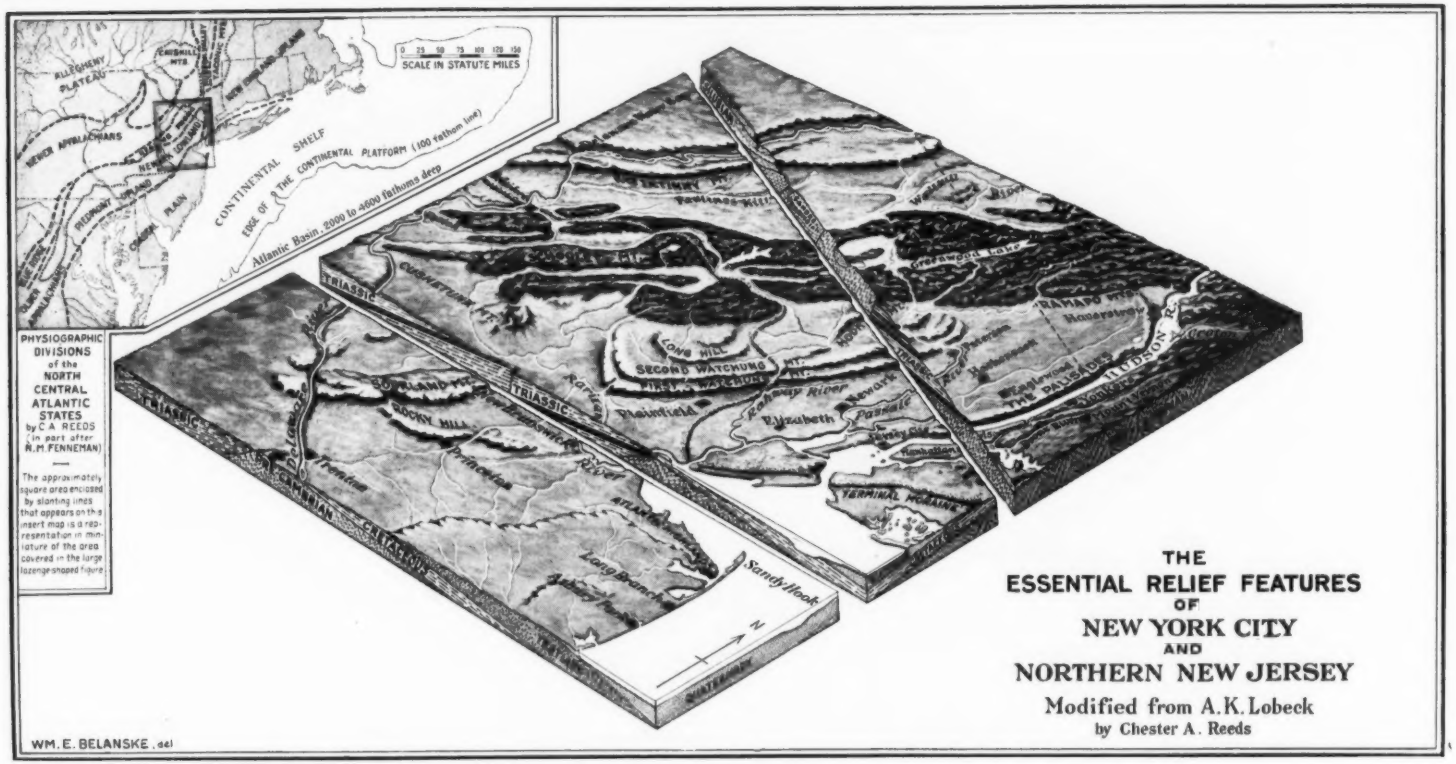
PORTRAIT OF A YOUNG PELICAN JUST ABLE TO WALK

A PELICAN PORTRAIT

then launches itself into the air with a great spring. On returning to the nest the bird sometimes alights on the edge, placing its great feet often within a couple of inches of the tiny baby with an accuracy and confidence that is surprising in a bird of such awkward appearance and such great bulk. While the babies are still very young and in the more or less naked condition, a good part of the time is spent by the old birds in standing between the sun and the young, giving them the blessed relief of shade—a luxury, indeed, on Bird Island. And yet how blind are certain instincts! Often my camera stood by the hour between the nest and the sun, in which case the old bird was entirely satisfied to stand on the *other* side of the nest, often with wings slightly spread to afford more shade, casting her great shadow on the bare ground, entirely content in her knowledge that she was doing her duty by her children!

When we first reached the island, the pelicans were very timid and would not permit close approach. However, as we wandered about day after day, this timidity decreased until only those birds immediately in our path arose, and even these returned to their duties almost at once. So the days fled. On the last day I tried an experiment: how close could I get to a wild pelican and secure a portrait? With this idea in mind I chose a nest easily approached—one which I could walk to with my head buried in my graflex camera and without dividing my attention between my feet and the bird. The first exposure I made at twenty feet, changed the film, and moved up. The old bird stood like a statue on the rim of her nest, the babies lying exhaused after a big meal. At fifteen feet I shot again, and again at twelve and at ten. Each time I moved slowly forward, making no sudden movements that might startle the bird into flight. Progress became slow now. Each time I stole a few inches forward, the bird spread her wings and crouched for a spring. I stopped, and the bird came back to rest. Again a few inches were gained. At eight feet another portrait: the image of the bird already covered the entire film. Slower and slower became my progress, and my every action was met with a definite reaction on the part of the bird. As long as there was no noise and no sudden movement, there seemed to be no limit as to how close I might approach. The noise of the shutter sounded to me like a clap of thunder. Surely, I thought, she will rise at the next exposure. Seven feet, and another portrait: just the head and neck now. Six feet! My back and arms ached with the tension of the last half hour, and the perspiration ran in little rivers down my spine. Forward again, infinitely slowly now. Almost within five feet of the bird! Suddenly the air was rent with a terrific explosion which took me so completely by surprise that I jumped. So did the bird, and the experiment was ended. The air was filled with a horrible odor. What on earth could have happened? I looked around, and there by my feet lay the remains of an ancient pelican egg whose tough shell had at last yielded to the internal pressure!

The launch returned shortly before noon, and it was with a feeling of regret that we packed up. And yet I was anxious to get back to the city: I could do no developing on the island, and so I had no idea how my pictures would turn out. Was I taking with me a photographic story of the life of the pelican, or was I packing back merely a batch of failures? I offer you some of the results herewith, and you can answer to suit yourself the question that was in my mind.



DIAGRAMMATIC RELIEF MAP OF NEW YORK CITY AND ADJOINING AREAS

GEOLOGY OF NEW YORK CITY AND ITS VICINITY

BY

CHESTER A. REEDS*

THE relief features of the New York City district consist of several distinctly different types, which have been developed by natural forces on rocks of unequal hardness. Some of the rocks are unconsolidated sands and muds and are of comparatively recent date; others are stratified with alternating hard and soft beds, which have been tilted or slightly folded and are older; still others of the same origin but far older have been so much altered and deformed during certain geologic periods that they have become crystalline and entirely changed in appearance, that is, metamorphosed. Volcanic rocks thick and homogeneous in character have also been injected into the area at different times, some very early, others later, but none very recently. These and some of the crystalline ones form the most resistant ridges. The distribution of the rocks is in the form of belts with a prevailing northeast-southwest direction.

The essential relief features and physiographic provinces of the area are shown in a graphic manner on the relief map, p. 430. They may be summarized as follows:

1. The continental shelf, which represents the submerged margin of the continent, extends eastward from the New Jersey shore for about 100 miles to the 100 fathom line. Beyond that point the sea floor drops rapidly to the great and extensive oceanic depths of 2000–4600 fathoms.

2. The Coastal Plain is that portion of the former submerged continental shelf which has been raised above the sea without apparent deformation. Three well defined elements of this plain appear:

(a) Its inner lowland, partly drowned in Long Island Sound, Lower New York and Sandy Hook bays, extends southwestward along the main railway lines through New Brunswick, Trenton, Philadelphia, Baltimore, and Washington;

(b) Its fall line features appear on the Delaware at Trenton, on the Schuylkill at Philadelphia, on the Potomac at the Great Falls above Washington, D. C., and on the James River at Richmond;

(c) Its cuesta forms the foundation of Long Island, the Atlantic Highlands, and the ragged front making up the hilly belt of southern New Jersey.

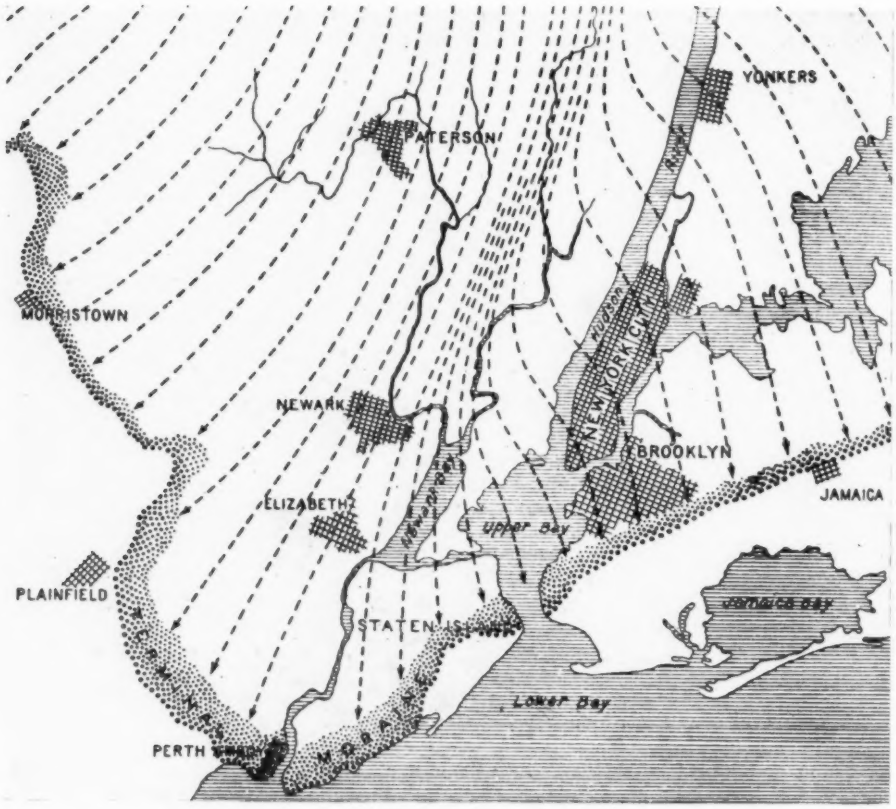
3. The Newark Lowland is a plain developed on inclined weak strata consisting of red sandstones and shales of Triassic age. The intrusive sheets of resistant volcanic rock form the prominent residual ridges known as the Palisades, Watchung, Hook, Cushetunk and Sourland mountains, and Long and Rocky hills.

4. The New England Upland is represented in the district by the Manhattan and Reading prongs. This upland consists of dissected and disordered crystalline rocks. The Manhattan prong extends down the east bank of the Hudson estuary from the Highlands to and including Manhattan Island. The north central portion of Staten Island is an outlier. The Reading prong extends as highlands from the gorge of the Hudson southwestward across New York and New Jersey to Reading, Pennsylvania.

5. The broad valley to the west occupied by the Wallkill and Paulins Kill is a part of the great Appalachian Valley, which extends from Birmingham, Alabama, to Lake Champlain. It is one of the prominent subdivisions of the Newer Appalachian physiographic province.

6. The narrow Kittatinny Mountain ridge dipping westward, represents the northeastern extension of the belt of

*Associate Curator of Invertebrate Palæontology, American Museum



Sketch map of New York City and vicinity, showing position of the terminal moraine and directions of the ice movement (indicated by the arrows) during the last or Wisconsin glaciation. After United States Geological Survey

newer and folded Appalachians of central Pennsylvania.

7. The Alleghany Plateau appears west of the Delaware River. Farther north in New York State the Catskill Mountains represent a subdivision of this plateau.

GLACIATION: The northern portion of the New York City district has been traversed at least four times by great sheets of ice which moved down from the Labrador center. These continental glaciers modified the drainage and the surface of the land over which they passed. The terminal moraine which represents the southernmost extent of the last ice field appears as a conspicuous ridge consisting of knobs and kettle holes on Long Island, Staten Island, and New Jersey. It continues westward across the United States to the Pacific Ocean near Seattle, Washington.

The drift bowlders and unsorted rock débris in the terminal moraine and northward give a clue as to the direction of ice movement. Large bowlders of crystalline rock from Jamaica and Hollis, Long Island, indicate that they were plucked out of the bed rock in the vicinity of Yonkers, Mt. Vernon, and other places in Westchester County, New York. Glacial-borne pebbles containing fossils and oolites have been found at Broadway and 191st Street. The fossils represent minute fragments of bryozoa and corals, of Devonian age, which are similar to those found at present in the Catskill Mountain region. The oolites, which

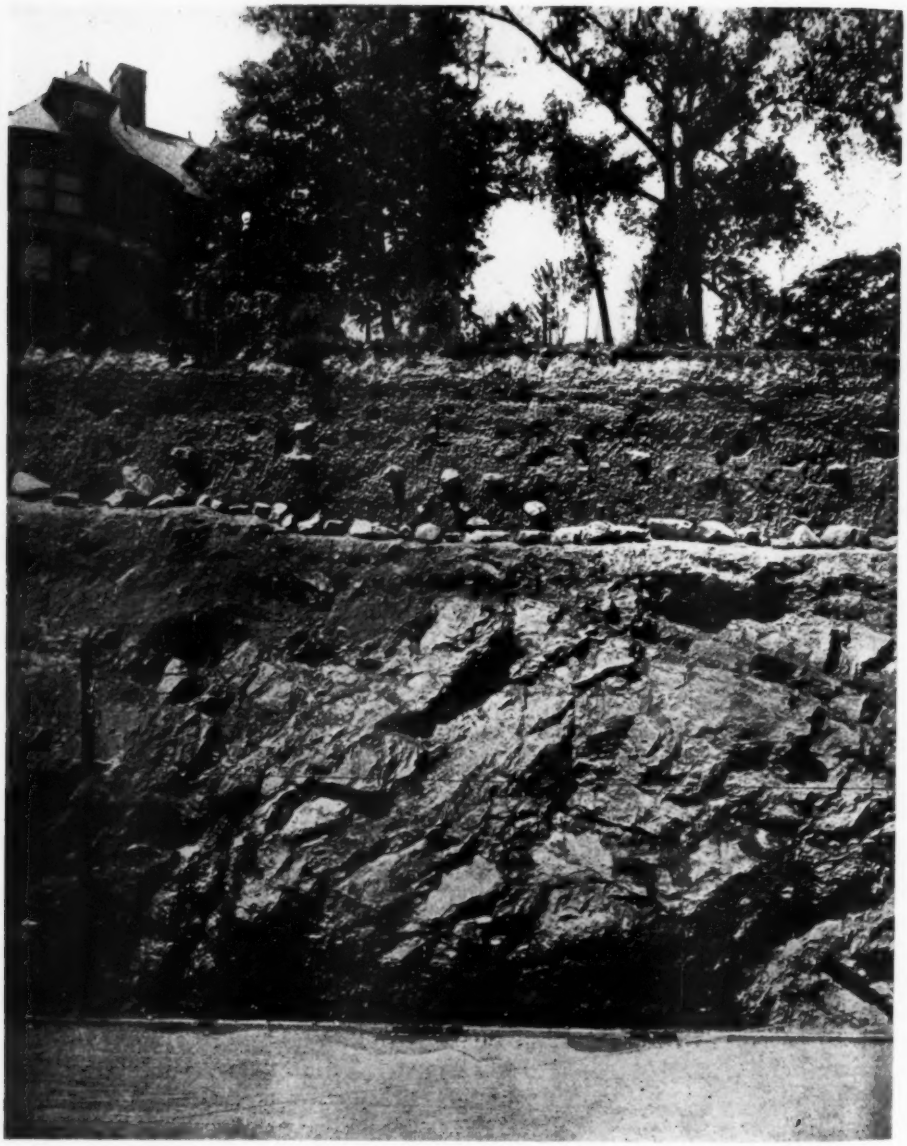
The "rocking stone," New York Zoölogical Park, an ice-transported bowlder resting on a glaciated surface

are small, concentric spheres cemented together, resemble fish roe. They, too, came from up-state New York. On Staten Island, Long Island, and Short Hills, New Jersey, many large drift bowlders of sedimentary origin and containing numerous marine fossils were derived from the exposures in east central New York State.

Each of the four continental glaciers of the Pleistocene epoch consisted of ice thousands of feet thick. They not only plucked out huge bowlders the size of a house and transported them long distances, but they also scoured off the soil-cover in many places and left bare rock surfaces, *roches moutonnées*, little deserts in fact, on which no plants other than lichens can grow. A good example of a glaciated surface with an ice-transported bowlder resting upon it is the "rocking stone" in the New York Zoölogical Park, Bronx, figured above.

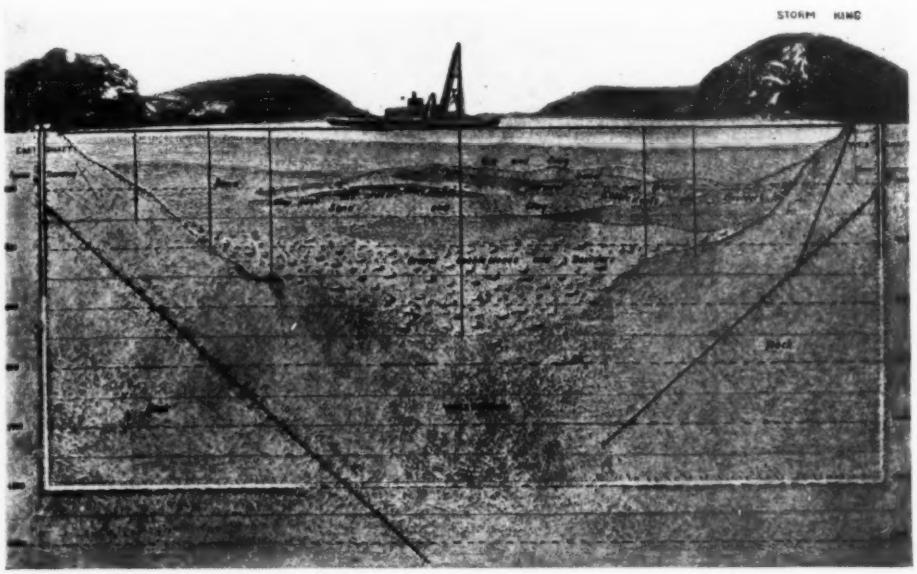
Rocks held firmly in the base of the ice served not only as abrasives but also as etching tools. Deep parallel grooves in crystalline rock appear at various places on Riverside Drive, particularly on the south side of the Drive where it leaves the Hudson River at about 200th Street. These glacial striæ running northwest-southeast give the direction of ice movement. Many diabase bowlders from the Palisades found in Yonkers and New York City indicate that the ice moved southeasterly, diagonally across the Palisades and the Hudson River, as shown on the diagram.

A stream leaving the front of the glacier oftentimes contained a large volume of water and had considerable transporting power. Hence pebbles,



Exposure of glacial till, containing sand, gravel, and bowlders, in contact with Serpentine rock, at Castle Point, Hoboken. After United States Geological Survey, Passaic Folio, No. 157

sand, and fine rock débris were carried in considerable quantity. In most instances the streams deployed fanwise almost immediately on their emergence from the glacial sheet and the material carried from the ice was dropped close to the margin of the glacier. The fans formed by single streams were usually small, being from half a mile to two miles in radius; confluent fans were larger, varying from one to six miles in radius. The materials are somewhat sorted and stratified and are called outwash deposits. These deposits occur at short intervals along the southern margin of the terminal moraine. Towns built



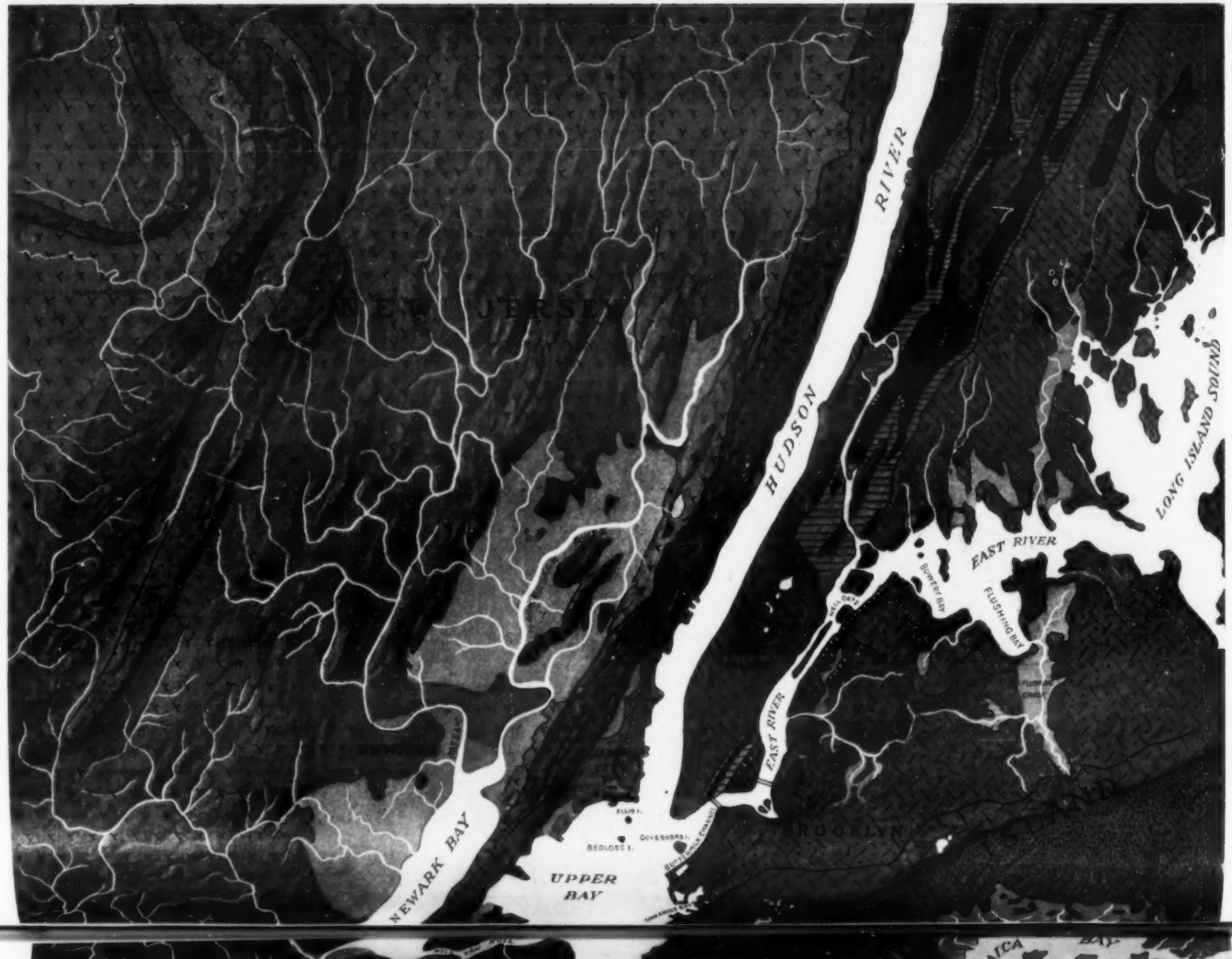
Cross-section drawing of the sediments in the Hudson River at Storm King Mountain, where is located the great siphon of the New York City aqueduct. From *Bulletin 146* of the New York State Museum

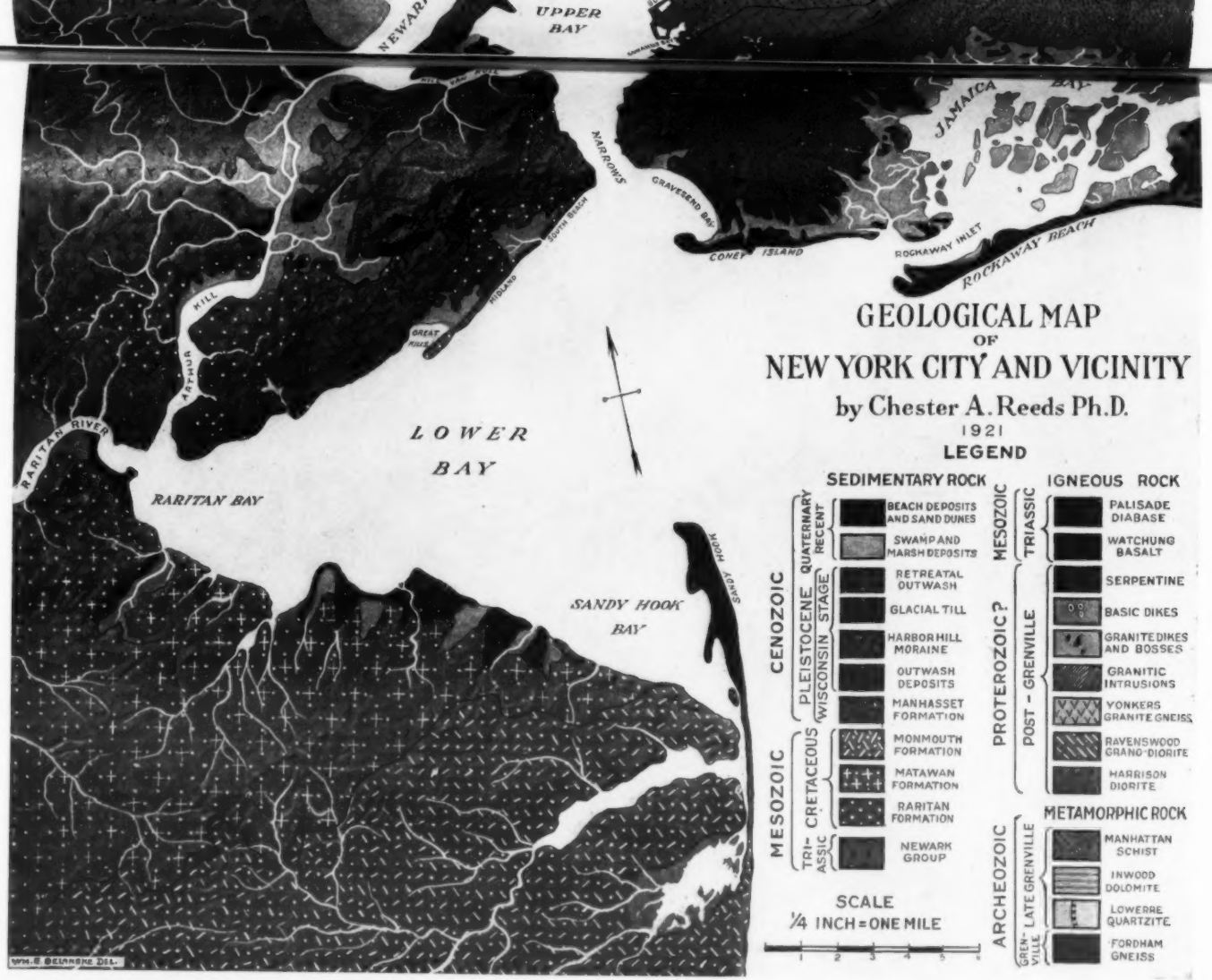
on some of the larger outwash plains are Plainfield, New Jersey; Flatbush and Hempstead, Long Island.

While glacial streams were depositing fan-shaped outwash deposits in many places along the ice front, a glacial lake, Lake Passaic, appeared to the south of the terminal moraine between the crescentic outline of the Watchung Mountains on the east and south and the New Jersey highlands on the west. The waters of the lake drained through the Muggy Hollow outlet at the southwest corner into the Raritan River valley. When the ice front retreated northward, the lake waters followed it and occupied the entire basin behind the Watchung Mountains to the west and southwest of Paterson, New Jersey. The numerous fresh-water marshes of today, along the upper course of the Passaic River, cover portions of the bed of this former glacial lake.

Great accumulations of glacial till, a mechanical mixture consisting of unsorted clay, sand, pebbles, and small bowlders, are found generally in the wake of the glacier. In the New York City district it varies from a fraction of a foot to 500 feet in thickness. A good exposure of it resting on Serpentine rock may be seen at Castle Point, Hoboken, New Jersey, p. 434. It oftentimes fills the pre-glacial stream valleys and frequently covers the leeward side of hills and the lower areas. Test holes in the Harlem River at High Bridge show that the channel has been filled up from 80 to 111 feet by glacial drift and river mud.

The glacial drifts and sediments in the Hudson River gorge at Storm King Mountain have been found by drilling operations to be between 768 and 995 feet thick, with an average of 800 feet. In the vicinity of the Pennsylvania Railroad tunnels at 32nd Street, New York City, the sediments are 300 feet thick, with a possible greater depth in an untested section in midstream. In the Lower Bay deposits accumulated to such an extent that the mouth of the river was almost closed to large ships. Some $4,000,000 have been spent by army engineers in dredging the Ambrose Channel 2000 feet wide by 40 feet deep,


HUDSON RIVER
LONG ISLAND SOUND
EAST RIVER
BOWERY BAY
FLUSHING BAY
EAST RIVER
NEWARK BAY
UPPER BAY
BEDLOES I.
GOVERNORS I.
BROOKLYN


UPPER BAY
NARROWS
GRAVESEND BAY
CONEY ISLAND
ROCKAWAY INLET
ROCKAWAY BEACH
JAMAICA BAY
SOUTH BEACH
MIDLAND
GREAT KILLS
ARTHUR KILL
RARITAN RIVER
LOWER BAY
RARITAN BAY
SANDY HOOK BAY
SANDY HOOK
WM. E. BELANSKE DEL.
GEOLOGICAL MAP
OF
NEW YORK CITY AND VICINITY
by Chester A. Reeds Ph.D.
1921
LEGEND
SEDIMENTARY ROCK
CENOZOIC
QUATERNARY
RECENT
BEACH DEPOSITS AND SAND DUNES
SWAMP AND MARSH DEPOSITS
PLEISTOCENE
WISCONSIN STAGE
RETREATAL OUTWASH
GLACIAL TILL
HARBOR HILL MORAINE
OUTWASH DEPOSITS
MANHASSET FORMATION
MESOZOIC
CRETACEOUS
MONMOUTH FORMATION
MATAWAN FORMATION
RARITAN FORMATION
TRI-ASSIC
NEWARK GROUP
SCALE
¼ INCH = ONE MILE
1 2 3 4 5
IGNEOUS ROCK
MESOZOIC
TRIASSIC
PALISADE DIABASE
WATCHUNG BASALT
PROTEROZOIC?
POST - GRENVILLE
SERPENTINE
BASIC DIKES
GRANITE DIKES AND BOSSES
GRANITIC INTRUSIONS
YONKERS GRANITE GNEISS
RAVENSWOOD GRANO-DIORITE
HARRISON DIORITE
METAMORPHIC ROCK
ARCHEOZOIC
LATE GRENVILLE
MANHATTAN SCHIST
INWOOD DOLOMITE
LOWERRE QUARTZITE
GREN-VILLE
FORDHAM GNEISS

so that the large ocean liners and other vessels may enter the harbor. From a point ten miles out from Sandy Hook to the edge of the continental shelf about one hundred miles distant, a well-defined river channel exists which increases in depth seaward. Near the brink of the continental platform it is 4800 feet deep. Glacial deposits appear over a portion of the course.

RECENT SHORE DEPOSITS: Sandy Hook, Coney Island, and Rockaway Beach are pronounced coastal irregularities. South Beach and Midland Beach, Staten Island, are less so. These features are temporary for they represent initial stages in the process of coastal simplification. After the initial reefs and barriers have become land, the lagoons behind them are likely to be filled with sediment and organic matter, forming land.

The development of curved spits and beaches along the New Jersey and Long Island shores is worthy of consideration. In the vicinity of Long Branch, New Jersey, the sea cliff indicates wave erosion. The eroded débris is shifted northward by the waves and currents and piled up along the beach which terminates in Sandy Hook. The tendency of the hook to turn westward is due largely to the strong westward sweep of the winds and tides of the Atlantic Ocean. This has been going on for some time, for Sandy Hook is a compound, recurved spit. Rockaway Beach is also compound in appearance while Coney Island is simple. The same forces which drift the sediments north along the New Jersey shore are moving them westward along the Long Island coast in the vicinity of Rockaway and Coney Island. As Staten Island lies across the path of these waves, South Beach and Midland Beach represent a barrier or bar which has been built up by the waves near the line of breakers. That the prevailing direction of currents along the Midland Beach is to the southwest is indicated by the development of a spit in the vicinity of Great Kills. Beach deposition and straightening of the coast line is also in progress on the south shore of the Lower Bay in the vicinity of Port Monmouth, New Jersey.

The estuaries and lagoons east of Port Monmouth are being filled with sediments derived from the land and the growth of vegetation, for, being in the lee of Sandy Hook and the barrier beaches, they are protected from strong sea waves. This is also true of Jamaica Bay, the Flushing Creek basin, Hackensack Meadows, Newark Bay, and the upper reaches of Arthur Kill. These bays and estuaries are the result of recent subsidence of the area. Thus the drowned lands, which now represent shallow sea floors, have been a factor in the placing and development of certain pronounced hooks and barrier beaches. The wind has also notably modified the deposits made by the waves and currents, for it has developed long ridges and sand dunes on the surface of the beaches.

In addition to the shore deposits which are of recent development there are rocks exposed in the New York district which have greater age and a more profound history. There are at least five series of them. While they are in close juxtaposition and have a well-established relation to each other, they are widely separated in origin by great intervals of time. Each series has had its normal period of development; the oldest, however, has suffered greater physical and chemical changes imposed upon it by mountain-making movements and other deformations which have affected it during the growth of the North American continent.

In passing from a consideration of the present shore developments to the oldest series of rocks exposed in the area we go rapidly backward from the Age of Man through the Age of Mammals, the Age of Reptiles, the Age of Amphibians, the Age of Fishes, the Age of Invertebrates, to the little-known but inferred Age of Unicellular Organisms. We shall not take the opportunity to note the

ever-changing shore line, the configuration of the lands and seas, and the great accumulation of sediments which have taken place slowly and repeatedly during these ages. We shall have to omit a discussion of the birth, rise, decay, and disappearance of mountain ranges which have succeeded one another in this and other parts of the continent. Standing on the threshold of the better known eras of geologic time, beginning with the Archæozoic, and turning our back on the hypothetical æons through which the earth must have already passed, let us approach the Present from the chronological point of view.

THE ARCHÆOZOIC ERA: In the dawn of life a series of limestones and associated sedimentary rocks were laid down in Canada near Ottawa, which have been called the Grenville series. According to Professor Berkey, of Columbia University, certain metamorphosed rocks in the Manhattan and Reading prongs of the New England upland are contemporaneous in age. The Fordham gneiss exposed in the Bronx and Westchester counties and northward has all the physical characters of the Grenville series. It consists primarily of granitic and quartzose black and white banded gneisses and schists of very complex composition and structure. Interbedded quartzite and limestones and old igneous intrusions are also included. Note the position on the accompanying geologic map, pp. 436-437.

Overlying the gneiss series in a conformable manner at certain localities is the Lowerre quartzite named after the locality in South Yonkers from which it was first described. It is a thin, schistose quartzite which varies in thickness from a fraction of a foot to 100 feet and rarely out-crops.

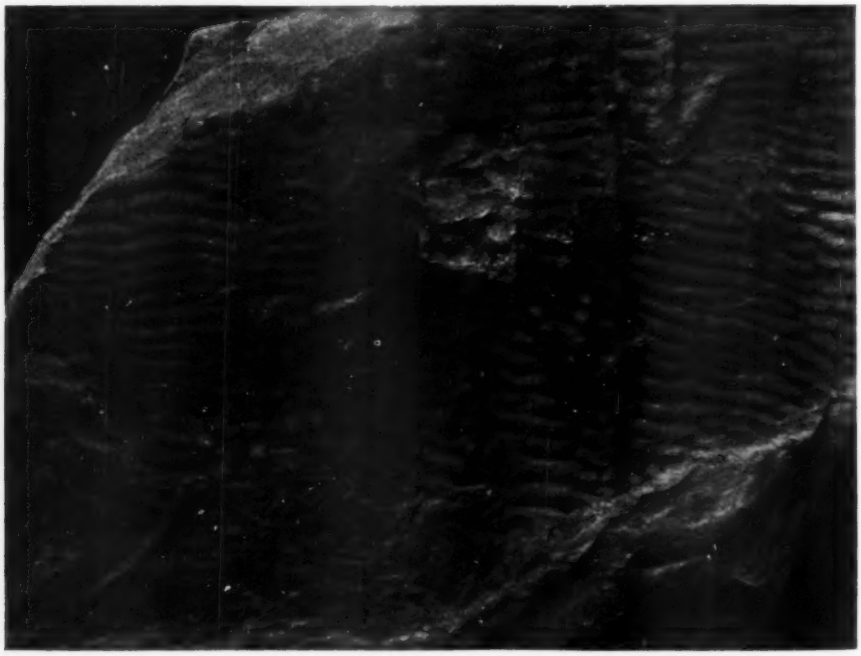
This formation is followed by a coarsely crystalline limestone locally tremolitic, micaceous, and pegmatitic, which varies in thickness from 200 to 800 feet. It is called the Inwood dolomite after the Inwood section of the city at the north end of Manhattan Island. Good exposures of the Inwood dolomite occur in the valley north of Dyckman Street, for instance at Marble Hill station on the New York Central Railroad.

Conformable and overlying the Inwood formation is a coarsely crystalline mica schist, very thick, and pegmatitic, which is called the Manhattan after the extensive exposures on Manhattan Island. The Lowerre-Inwood-Manhattan series is regarded as late Grenville in age. This and the Fordham series constitute the originally sedimentary beds of the Archæozoic Era exposed in the New York City district.

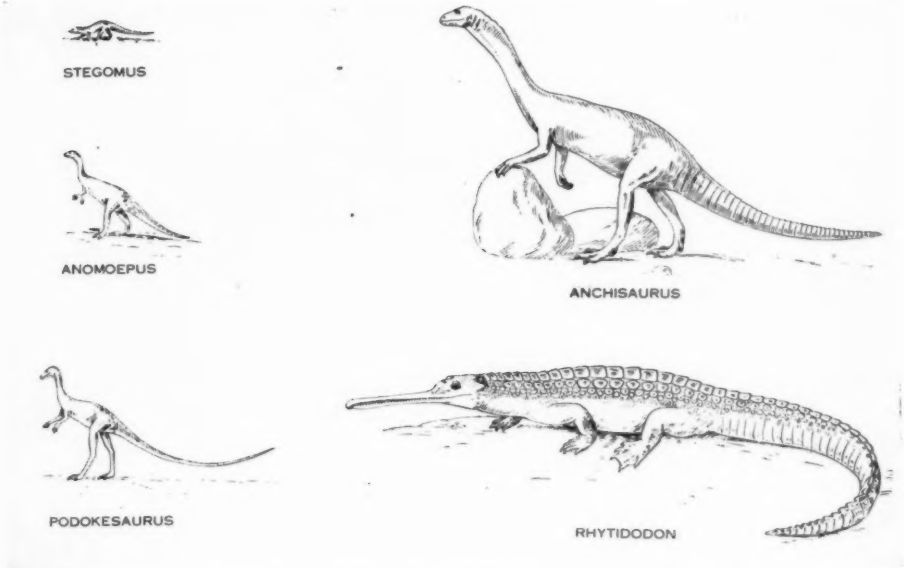
THE PROTEROZOIC ERA, IGNEOUS ROCKS: All igneous rocks of the crystalline area under consideration are younger than the sedimentary members since they have been intruded. But they are not all of the same age or kind. There are granitic stringers and sills which may date back to the close of the earliest of these sedimentary periods, since they partake of all the metamorphic changes that characterize these ancient strata including recrystallization and flowage. The most striking examples are the Yonkers granite gneiss, a sill, and the Ravenswood granodiorite, a boss. Some of the pegmatite streaks and basic intrusions belong to a period of more extensive metamorphic activity and penetrate the Inwood dolomite and Manhattan schist. Examples are the Harrison diorite, basic dikes, granitic dikes, bosses, and intrusions as shown on the accompanying geologic map, pp. 436-437. Serpentine, which is a metamorphic alteration product, has a like origin and distribution.

The entire basal series of rocks have been folded, crumpled, faulted, crushed, injected, intruded, and intensely modified by recrystallization, nevertheless, they retain the fundamental association and essential character of an originally sedimentary series. Many of the gneisses, a few of the schists, all of the granites

Slab showing passage of two Triassic dinosaurs after a shower. The raindrop impressions are represented by small pits. After R. S. Lull



Impressions of the feet and tail of a Triassic dinosaur on a ripple-marked surface. Specimen from Pleasantdale, New Jersey



Certain types of dinosaurs of Triassic age which inhabited the New York, Virginia, and Connecticut valley basins

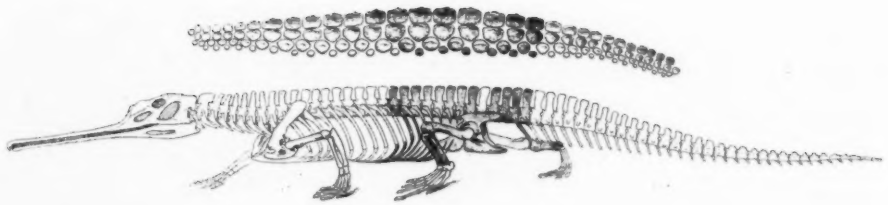
and diorites are of igneous origin and occur as sills, dikes, or bosses, cutting the metamorphosed sedimentary members. They, too, have been greatly metamorphosed and are very ancient, perhaps late Archæozoic or Proterozoic.

THE PALÆOZOIC ERA: The Palæozoic rocks and fossils, which represent a tremendously long period of time and follow the Proterozoic Era, are not found in the immediate vicinity of New York City. They appear, however, in great force in western New Jersey, New York, Pennsylvania, and the Mississippi valley states.

THE MESOZOIC ERA, TRIASSIC PERIOD: From the Hudson River westward to the crystalline rocks of the New Jersey highlands occur a thick series of reddish brown sandstones, shales, and conglomerates, called the Newark group, which dip 10 to 15 degrees to the northwest. Near Philadelphia, Trenton, and New Brunswick, the Stockton, Locatong, and Brunswick formations have been differentiated, but not beneath the glacial drift cover to the northeastward. These sedimentary rocks were deposited in a trough or graben with faulted margins which extended southwestward from the Hudson River across central New Jersey, Pennsylvania, and Maryland into southern Virginia. In all probability a major stream with lateral tributaries occupied the depression. The region was presumably high and arid. Ripple marks, mud cracks, rain drop impressions, and footprints of reptiles are common, especially in the Brunswick shale, and indicate flood plain and shallow water deposition. Restorations of the dinosaurs, *Stegomus*, *Anomoepus*. *Podokesaurus*, *Anchisaurus*, and *Rutiodon* (*Rhytidodon*), which inhabited this zone and the Connecticut Valley, are shown in accompanying illustrations, pp. 441-42-43. Only one skeleton, the Fort Lee *Rutiodon*, pp. 442-43, has been found near New York City. Fossil fishes and a small crustacean, *Estheria ovata*, have also been found. The fossil remains indicate Triassic age, the initial period of the Mesozoic Era, sometimes called the Age of Reptiles.

Three successive lava flows which were extruded during the deposition of the

Fort Lee phytosaur, *Rutiodon manhattanensis*. Photograph of the skeleton as preserved in the original matrix. About $^{1}/_{10}$ natural size. A description of it was published by the American Museum of Natural History, *Bulletin XXXII*, pp. 275-82, 1913



Restoration of the skeleton and dermal plates of *Rutiodon manhattanensis*. The shaded portion represents the parts preserved in the Fort Lee specimen. After R. S. Lull

Men excavating the skeleton of the Fort Lee phytosaur on the right bank of the Hudson River, opposite New York City. The specimen was found about twenty feet below the thick sheet of diabase of the Palisades in a red sandy marl

Newark beds have been subsequently faulted, flexed, and tilted into their present position. Since that event erosion has removed a great thickness of the sedimentary rocks and the upturned edges of the lava sheets are now exposed. The First and Second Watchung Mountains and Hook Mountain represent these three basaltic flows. The lowest, First Mountain, is about 600 feet thick, Second Mountain 800 feet, and Hook Mountain 300 feet. About 600 feet of red sandstone and shale separate the first and second, and 1500 feet the second and third. Red Triassic sandstone and shale are also found above and below these volcanic rocks.

The Palisade diabase is a great sheet of igneous rock, from 350 to 1000 feet thick, which was intruded among the lower strata of the Newark group. It extends from Staten Island northward along the west bank of the Hudson River to Haverstraw. At its southern exposed extremity it is practically at sea level, while at the north it is 700 feet higher. Throughout most of its extent it presents an escarpment of high cliffs with vertical columns of rock which were developed during the cooling stage and which suggest the name Palisades.

Cretaceous Period: Stratified rocks which represent the closing stage of the Age of Reptiles rest unconformably upon the Newark group in New Jersey and upon the crystalline basal complex in Staten Island and Long Island. Except for a few exposures along the north coast and the interior of Long Island the Cretaceous sediments are hidden by glacial deposits of Pleistocene age. Their presence, however, is ascertained from numerous deep-well records. In the unglaciated area south of Raritan Bay they are exposed over extensive areas. Here three well-defined members appear, the basal Raritan formation of plastic clays, the Mattawan formation of clay marls, and the Monmouth, including the Rancocas and Mansquan formations of green sand and marls. Fossil marine invertebrates and plant remains indicating Upper Cretaceous age are found in some of these beds. The Cretaceous deposits of Long Island, which average 1550 feet in thickness, vary greatly in composition within short distances and are, on the whole, more sandy than those of New Jersey. An exposure may be seen at Elm Point on Great Neck, Long Island.

The inclination to the southeast of the bed rock surface on which these sediments were deposited is about 40 feet to the mile in New Jersey, 80 feet near Oyster Bay and Huntington, and 40 feet at Port Jefferson, Long Island. The dip of the beds, which is the same as the slope of the unexposed floor, probably decreases toward the east and south. This old Cretaceous floor is still preserved inland in the crests of the Palisade and Watchung ridges, Schooley Mountain and Kittatinny Mountain of New Jersey and in the truncated folds of the Appalachian Mountains west of Harrisburg, Pennsylvania. Locally in Long Island the weak upper beds of the Cretaceous series have been greatly folded and contorted by the passage of the Pleistocene glaciers over them.

The Cenozoic Era, Pleistocene Events: Four glacial and three interglacial stages are represented on Long Island. The periods of glaciation correspond to the Nebraskan, Kansan, Illinoian, and Wisconsin of the Central United States, and to the Günz, Mindel, Riss, and Würm of the Alps Mountains. Locally they have been named by Mr. M. L. Fuller, of the United States Geological Survey, the Mannetto, Jameco, Manhasset, and Wisconsin stages and are represented primarily by gravel and morainal deposits. The only ones represented within the limits of the accompanying geological map are the Manhasset and Wisconsin. The outwash, terminal moraine, till, and retreatal outwash deposits of the Wisconsin stage are far more extensive and readily examined than the similar accumulations of the older stages since they were the

last and cover in large part those made during the preceding glaciations.

The First Interglacial stage, the post-Mannetto, was long, for a great erosion unconformity exists. Following the deposition of the Mannetto gravel of the First Glaciation, there was a period of uplift and erosion in which the Mannetto was cut to a depth of 300 feet below sea level, as shown by the depth of the buried Jameco channel in Long Island. The great length of this period of erosion, indicated by the almost complete removal of the thick Mannetto gravel from the Long Island region, is in harmony with the time required for the cutting of the Hudson River rock gorge to a depth of 750 feet below present sea level. The gorge proper appears to be filled solely with Pleistocene materials as indicated by the Storm King and other borings; hence, its cutting is to be referred to a date later than the deposition of the latest Tertiary beds in New Jersey.

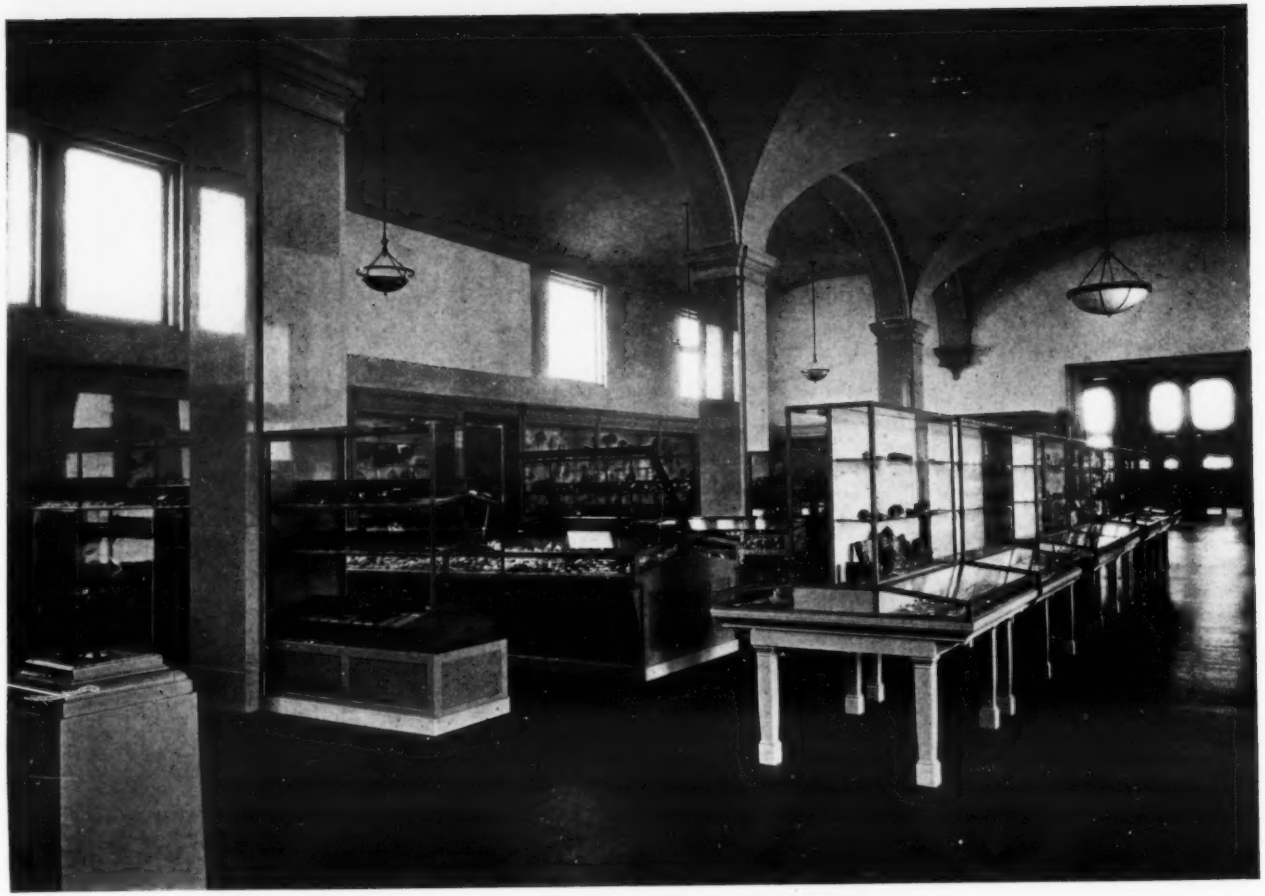
The narrow, steep-sided and deep outer cañon of the submarine channel, if due to stream erosion, must be referred to an elevation of great magnitude, 4800 feet, occurring at the close of the post-Mannetto erosion stage. The great drops or falls in its beds are characteristic of a juvenile stream or old one which has been rejuvenated. As only the edge of the continental shelf was notched, the epoch of maximum elevation must have been brief.

During the Second Interglacial stage, the Yarmouth of the Mississippi Valley, the Gardiners clay was deposited in Long Island. It was followed by a transitional epoch represented by the Jacob sand. Throughout the time of the Second Glaciation, the Second Interglacial, and the Third Glaciation, the channel of the Hudson remained constantly below sea level. The deposits, which have a combined thickness of about 500 feet, doubtless obliterated the upper reaches of the submarine Hudson channel.

The Third Interglacial interval, the Vineyard, is represented by (a) a great erosion unconformity, and (b) the Vineyard formation, consisting of marine deposits and peat. The valleys in the Manhasset deposits, although somewhat modified and partly filled with the later Wisconsin accumulations, are known to extend some distance below sea level at many points along the north shore, indicating a former higher position of the land. The present upper submarine channel of the Hudson, which has a depth at its outer end of 350 feet, suggests that the land must have been elevated to that extent during the Vineyard interval.

There are no erosion channels referable to Wisconsin or post-Wisconsin elevation on Long Island. The upper end of the Hudson channel, however, between Sandy Hook and Rockaway Beach, has been obliterated in part by Wisconsin outwash and in part by the shifting of the sands by the littoral currents that now sweep along the coast.

Thus in this rapid survey we have considered very briefly the Archæozoic, Proterozoic, Palæozoic, Mesozoic, (Triassic, Cretaceous), and Cenozoic (Pleistocene) series of rocks as represented in New York City and its vicinity. They are replete with interest but they represent only a few isolated and incomplete chapters of the geologic history of North America. The long Palæozoic era, including the Age of Invertebrates, Age of Fishes, and Age of Amphibians, is not represented by sediments in the area of the geologic map, pp. 436-37. The Jurassic and Lower Cretaceous periods occupying the middle portion of the Mesozoic era, the Age of Reptiles, are also not represented in this district. Likewise the Tertiary series, corresponding to the Age of Mammals, appears outside the area. The Pleistocene glacial deposits, which are contemporaneous with the Age of Man, are rather fully represented but, as yet, no human remains have been found in them in this area or anywhere in North America.



GENERAL VIEW OF MORGAN MEMORIAL HALL

The specimens receive emphasis by contrast with their unobtrusive surroundings, the subdued tone of the cases and backgrounds merging into that of the walls and ceiling

THE MORGAN MEMORIAL HALL OF MINERALS AND GEMS

BY

HERBERT P. WHITLOCK*

WITH the completion of the Morgan Memorial Hall of Minerals, the construction of which was made possible through the generosity of Mr. George F. Baker,[1] the American Museum of Natural History has been enabled to place before the public, in surroundings and under conditions of display commensurable with their importance, the finest collection of minerals and gems to be found in America.

Because both in conception and details the presentation of these two great collections involves, from a museum point of view, the working out of several unique ideas, it may be well to describe briefly the present installation and to point out in what respects it differs from that of a year ago. In thus contrasting the new with the old we are faced at the outset with two very significant paradoxes. Regarding the disposition of the collections, the Morgan Memorial Hall now contains the mineral collection, which still occupies the same space as formerly (the southwest wing on the fourth floor), and the gem collection, hitherto on exhibit in the west corridor. Despite this consolidation, the present installation gives the impression of more free space than was conveyed by either of the former installations. This result was achieved by the judicious introduction of vertical methods of casing in both sections of the installation. In respect to the lighting, although the lower portions of the windows on the south side have been closed to accommodate vertical wall cases, the hall is very much better lighted than it was formerly. This is due to the introduction of ground glass in the north windows and in the upper portions of the south windows, the diffused light thus obtained, together with the light reflected from the vaulted ceiling, giving an illumination which is both ample and restful.

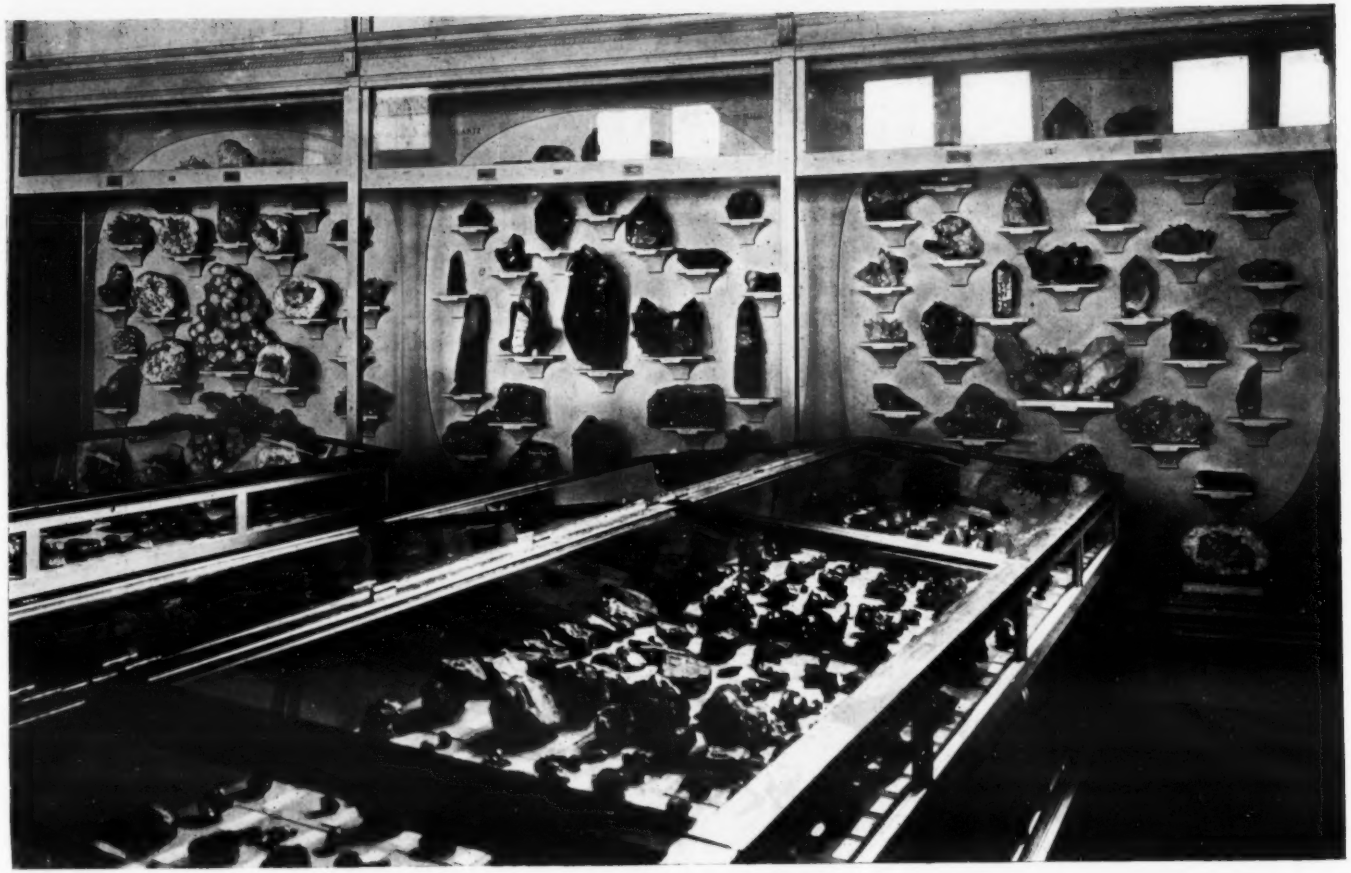
In the general scheme of display the specimens have been emphasized by a consistent adherence to the principle of subordinating their surroundings. For instance, if the case containing a specimen, and the shelf, bracket, or mount that supports that specimen are brought unduly into prominence, they will detract from its effective presentation. The cases, backgrounds, and mounts have, therefore, been tinted to harmonize with and merge into the color of the walls and ceiling. That such an innovation in museum display methods accomplishes the result of effectively presenting the specimens to the eye, seems amply proved in the case of the present installation, where, especially in the vertical wall panels, the specimens are individualized with striking effect.

The twenty-eight vertical panels of the cases which extend along the east, south, and west walls of the hall have been planned with three distinct purposes in view: the creation of an effective and decorative motive of wall display; the assembling of the most highly attractive pieces of the collection into a relatively small and easily viewed series, calculated to interest the casual and uninstructed visitor; and the disposal of the large specimens, which could not be conveniently displayed in the flat cases of the main installation, in reasonably close proximity to their appropriate positions in the latter arrangement. The second of these three functions is the one which has been especially developed and emphasized, the wall panels constituting, as it were, an introductory collection

[1]For an account of Mr. Baker's valued gift, made in memory of his friend, the late John Pierpont Morgan, the reader is referred to NATURAL HISTORY, March–April, 1922, p. 180.

*Curator of Mineralogy, American Museum

The specimens receive emphasis by contrast with their unobtrusive surroundings, the subdued tone of the cases and backgrounds merging into that of the walls and ceiling



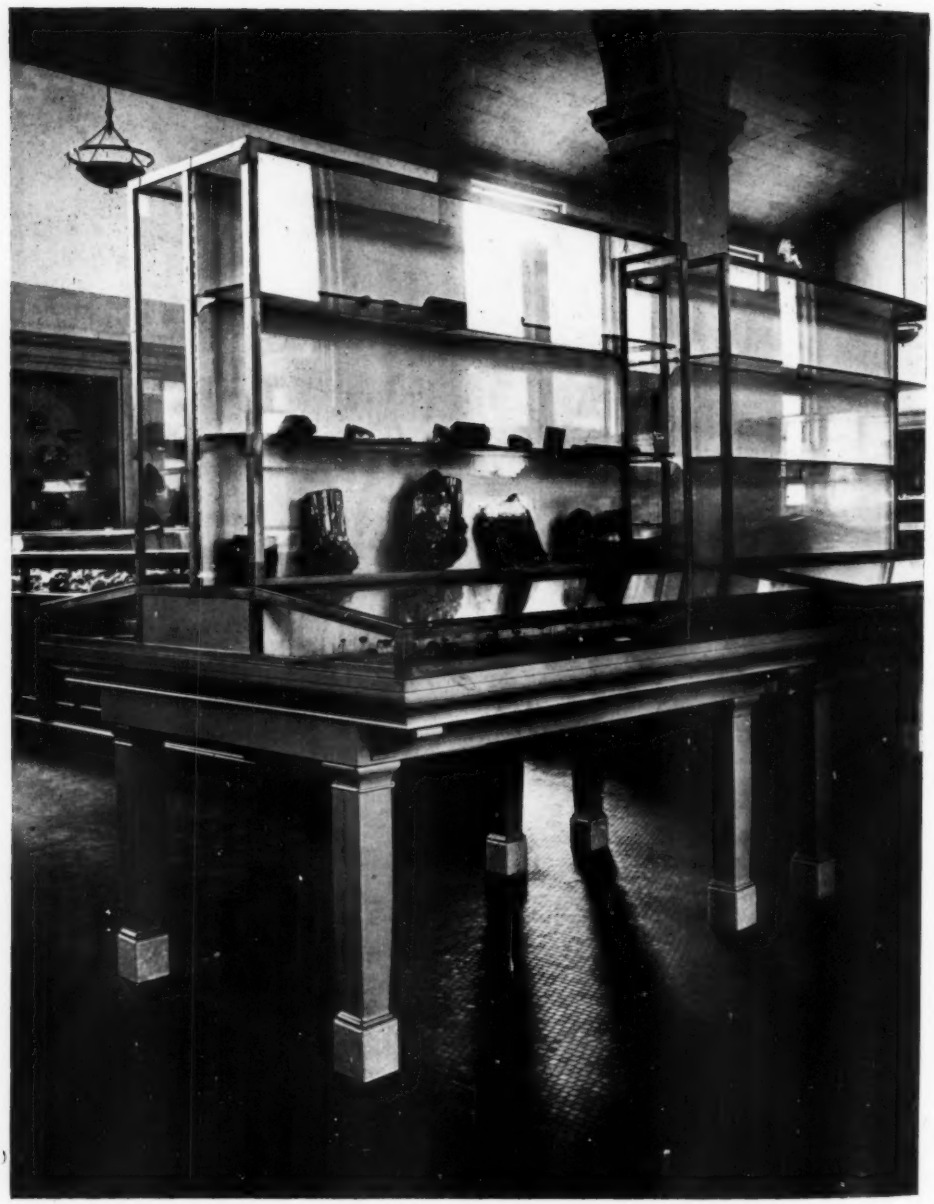
A WALL DISPLAY OF MINERALS

Twenty-eight vertical panels are arranged in the cases along the walls. The interest of the visitor is aroused by the striking exhibits displayed on these panels, while in near-by cases are hundreds of related specimens offering opportunities for more extensive study

Twenty-eight vertical panels are arranged in the cases along the walls. The interest of the visitor is aroused by the striking exhibits displayed on these panels, while in near-by cases are hundreds of related specimens offering opportunities for more extensive study

GEM STONES SEEN TO BEST ADVANTAGE

The new and unique method of showing the gem stones on inconspicuous glass supports carries out the basic idea of subordinating the surroundings of the specimens. An example of the old style of mounting on wire supports is shown for comparison in the case of a specimen in the upper left corner



UNCUT GEM MATERIAL AND FINISHED JEWEL

In the cases of the gem collection the relation between the minerals and the gem stones cut from them is emphasized by the exhibit of uncut gem material in the upper section of the cases and the display of the cut gems in the table section

from which the visitor may glean the essential significance of the entire exhibit. To this end much thought has been given to the composition of the panel labels, which not only explain the contents of their respective panels but, taken in series, furnish a brief and concise statement of the principles of mineral formation. Beginning with the native elements, representing the essence

of simplicity in the composition of minerals, one is led by almost insensible gradations to the more complex combinations of elements. Each panel grouping of specimens thus illustrates, as it were, a text which, taken by itself, conveys an important truth, and, considered together, the whole series furnishes a key to the entire contents of the hall.

In thus arousing the interest in what we may call the *key exhibit*, attention is directed to the vast resources of the main installation disposed in adjoining cases, the position of which is indicated at the bottom of the panel labels. In this way the visitor whose interest has been stimulated in some section or phase of the key exhibit is led to the part of the installation where examples of what he seeks are multiplied in great variety.

In the installation of the principal mineral collection, much space has been gained and the general appearance of the exhibit has been greatly improved by introducing alongside each of the twelve piers which support the vaulted ceiling high, free-standing cases with inclined shelves. This arrangement breaks the monotony of a continuous succession of flat glass lids, such as in the previous disposition of the cases presented to the eye literally a "sea of glass."

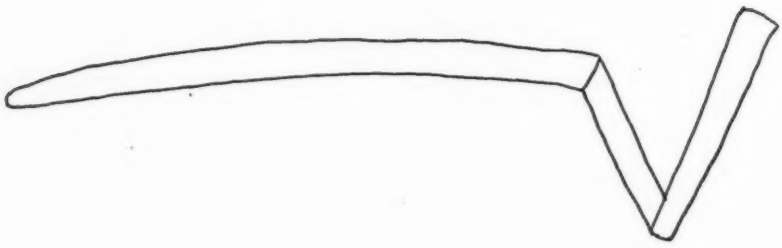
In abandoning the former hall of gems and placing the gem collection in Morgan Memorial Hall, two distinct objects were accomplished. Thus was gained for the gem collection the advantage of far better natural lighting and the no less great advantage of close juxtaposition to the mineral collection with which it is of necessity affiliated as a natural adjunct. The present series of gem cases are arranged in double units along the axis of the hall, in this way profiting by light from both north and south windows. The vertical section of each unit is used in general to display the raw gem material of the mineral illustrated, and the flat section is reserved for the cut, engraved, or carved stones.

As in the instance of the vertical wall panels, the explanatory labels attached to the gem cases are made an important feature. Here, however, the text of each label is somewhat more extended to meet the need of the average visitor for information regarding objects about which his interest has already been aroused. Following the same line of presentation, the subject matter of the label is somewhat more detailed and the facts are presented with less breadth of treatment.

A notable feature of this installation is the use of a new type of gem mount for displaying cut stones. The gems are supported each on a structure of thin glass rods which is practically invisible except at close range, and displays the specimen against its background without the interference of the shadow which would be always present were the gem in contact with that background. In this way the color by transmitted light is shown to best advantage and without the appearance of opaque support so characteristic of wire mounts.

In some instances a diaphragm background is introduced, as in the cases containing the series illustrating the antique and prehistoric uses of gems, where strings of antique beads are shown to advantage against a vertical background.

Throughout the installation care has been taken to display individual specimens to the best advantage, emphasizing the large and fine pieces and contrasting by juxtaposition slight differences of color. Where several small stones are available, these have been grouped in circles, festoons, pendants, and other jewelry groupings, to conform to slight differences in size and style of cutting. In this way certain features of the gem collection which are of interest to the jeweler are emphasized, and the collection acquires an educational value in this little-known field of the many-sided science of mineralogy.



Diagrammatic figure of a backbone of some unknown fish, found by Dr. E. W. Gudger, embedded in the mesentery of a barracuda at Tortugas, Florida

FOREIGN BODIES FOUND EMBEDDED IN THE TISSUES OF FISHES

BY

E. W. GUDGER*

THAT the larger fishes, especially the sharks, do not discriminate in regard to the things they swallow, is known to all students of ichthyology and is not wholly unknown to the general public. From my own dissections of sharks I have made a list of all sorts of incongruous materials found in their stomachs: heads and horns, hoofs with iron shoes, bones of all kinds, the skeletons of birds and their feathers, the beaks of turtles and their scutes, tin cans, and a host of other preposterously indigestible things. Furthermore, to my own list I have added data from various other writers until the list is almost as large as it is varied and incongruous. But to the average student of fishes, as well as to the readers of NATURAL HISTORY, I suspect that the title of my article will seem strange and unusual.

Many years ago, while dissecting a fish in the laboratory of the United States Bureau of Fisheries at Beaufort, North Carolina, I found embedded in a fold of the mesentery a hard, fairly straight body from five to seven inches in length and with approximately the diameter of a small lead pencil. On cutting it out and carefully freeing it from the enveloping tissues, I found it was a mummified pipefish, which had been swallowed at some previous time, had worked its way out into the mesentery and had there become preserved. The pipefish was very much shrunken, consisting of hardly more than the bony framework and the tough integument, and was very hard, offering considerable resistance to the scalpel; but there was no evidence that putrefaction had taken place, nor had the containing fish suffered any apparent injury. My notes made on the occasion having been destroyed and the mummy lost, further information unfortunately cannot be given.

In July, 1912, while dissecting a barracuda (*Sphyræna barracuda*) at the Marine Biological Laboratory of the Carnegie Institution of Washington, which is located at Tortugas, Florida, I found a similar body embedded in the mesentery. Recalling my past experience, I at once suspected that this also was a pipefish, but when it had been freed from the mesentery, it proved to be merely the backbone of some unidentifiable fish. It was about five inches long

*Associate in Ichthyology, American Museum of Natural History.

and fairly straight save at the upper end, where it was bent in the fashion shown in the figure on page 452. This phenomenon was reported and the figure published in my paper on the barracuda.[1] How the pipefish referred to in the previous paragraph could have worked its way through the intestinal wall into the body cavity can at least be conjectured, but how this vertebral column could have done so is hard to conceive.

Becoming interested in this phenomenon and being informed that the late Vinal Edwards, the veteran collector at the station of the United States Bureau of Fisheries at Woods Hole, Massachusetts, had noted similar occurrences, I wrote to him for additional data. Under date of February 3, 1917, he answered that since 1908 he had noted three such occurrences; namely, in a hake, a swordfish, and in a sculpin. In the first two there was "a skeleton of a fish in the meat near the backbone." In the case of the hake the embedded skeleton was about ten inches long and in that of the swordfish about a foot long. In the sculpin he found what looked like a pipefish. These were all sent to the Bureau of Fisheries in Washington, but as the war was at the time engrossing men's energies, the specimens were mislaid and cannot now be found.

Bearing these things in mind, when I became joint editor with Dr. Bashford Dean, of the *Bibliography of Fishes*, which is being issued by the American Museum, I noted down all similar occurrences in the course of our indexing the vast literature on fishes brought together in this work. The data thus gathered are added herewith to that presented above, in the belief that the readers of NATURAL HISTORY will find them of interest and possibly of value.

The first of these accounts is that given by Captain N. E. Atwood[2] before the Boston Society of Natural History, April 1, 1857. He is quoted as saying that:

"The cod often swallows alive the tant or sand-eel and the pipe-fish, both having heads very much elongated anteriorly and pointed. These fish sometimes pierce the stomach of the cod and escape into the abdominal cavity, and there they are found in a perfect state of preservation, adherent to its walls, but changed in color to a dark red, and in substance so hard that they are not readily divided with a knife. They have to be cut away before the cod can be split open. The fish is always in good health apparently, and there are no marks of inflammation about the stomach or abdominal cavity, unless the material of attachment be considered as such."

The next account was also given by Captain Atwood[3] before the Boston Society of Natural History on January 5, 1859, and is thus reported in the *Proceedings* of that society:

"Fish are often swallowed by the cod, pass from their stomach into the abdominal cavity, and are there found mummified and adherent to the inner walls; he presented a specimen, apparently of the eel family, thus preserved and hardened, which he had taken from the abdominal cavity of a pollock. . . . He presented two large cod hooks, with portions of the line attached, which he had taken from the livers of apparently healthy cod; the greater part of the hooks was buried in the organ, and must have remained there, he thought, at least twelve months; they must have been swallowed, broken off, and have worked their way through the stomach into the liver."

Nine years later (1868) Captain Atwood[4] again addressed the Boston Society of Natural History on this subject. The report, as recorded by the secretary, reads as follows:

"Captain Nathaniel E. Atwood exhibited a codfish which presented a curious appearance. A number of sand-eels were seen in the walls of the abdominal cavity; they were so hard as to resist the knife, not at all decomposed, and in many places with a sort of earthy crust or membrane of their own. Capt. Atwood said the occurrence was not an unusual one, and the cod, being in good condition, had apparently not suffered at all by this phenomenon."

Thereupon the presiding officer, Dr. Jeffreys Wyman,[5] remarked that there were three fairly well defined features presented by this fish. In the first place, the eels were outside the cavity of

[1]Gudger, E. W. "*Sphyræna barracuda:* its morphology, habits, and history." Publication No. 252, Carnegie Institution of Washington [D. C.], 1918, p. 72, text-fig. 5.

[2]Atwood, N. E. [Notes on the habits of some marine fishes]. *Proceedings*, Boston Society of Natural History for 1856–59, Vol. 6, p. 176.

[3]Atwood, N. E. [Foreign bodies found in the body cavity or in the liver of the codfish]. *Proceedings* Boston Society of Natural History for 1859–61, 1861, Vol. 7, p. 4.

[4]Atwood, N. E. [Exhibition of and remarks upon a codfish which had a number of sand eels in the walls of the abdominal cavity.] *Proceedings* Boston Society Natural History for 1866–68, 1868, Vol. 11, p. 364.

[5]Wyman, Jeffreys, [On the occurrence of sand eels in the abdominal cavity of the cod]. *Proceedings*, Boston Society of Natural History, for 1866–68, 1868, Vol. 11, p. 364.

Of all the strange objects found embedded in the tissues of fishes, none will perhaps excite greater wonder than the curiously shaped knife, with handle of brass, here reproduced in its natural size. The cod that swallowed this knife at least had the discretion to do so when the blade was closed, for the knife was shut when found. After Collins

the stomach; in the second place, they had an investing membrane of their own although they had apparently been embedded in the cod for some time, and finally—the most remarkable point of all—they showed no signs whatever of putrefaction. The fact that they had not decomposed he thought, on the theory of Pasteur, was due to the absence of any disturbing agency.

Apropos of the strange things swallowed by fishes and in anticipation of the embedded foreign body next to be noted, attention is here called to a letter from Capt. J. W. Collins to Prof. S. F. Baird, published in the United States Fish Commission *Bulletin* for 1884, p. 175. In this Captain Collins puts on record the finding in the stomach of a large codfish taken on Le Have Bank, of a knife known as a "haddock ripper."

However, in 1886, Captain Collins[1] recorded what is undoubtedly the most remarkable instance known of a foreign body embedded in the flesh of a fish. We will let him tell his story in his own words:

"While discharging a fare of codfish from the schooner Vinnie M. Getchell, at Gloucester, Mass., on September 15, 1885, Capt. John Q. Getchell, master of the vessel, found embedded in the thick flesh of a large cod a knife of curious workmanship, represented by the accompanying illustration, which is of full or natural size.

"The fish in which the knife was found was one of a fare caught in 75 fathoms of water on the northeast part of George's Bank; it was apparently healthy, being thick and 'well-fed,' and, according to Captain Getchell, would weigh about 40 pounds after being split, or say 60 pounds as it came from the water. The general excellent quality of the fare of fish attracted considerable attention from people who saw them, and led to the discovery of the knife. Some remarks having been made concerning the fish, Captain Getchell lifted several of them from a tub (where they had been thrown to wash after being weighed) and exhibited them to the by-standers, commenting on the size and thickness of the specimens. Holding one across the edge of the tub in a semi-curved position, he ran his hand over the thicker portion of the fish to call attention to its fatness. In doing so, he felt something hard beneath his fingers, and further examination produced the knife. Of course much surprise was expressed by those present who had never before seen such a strangely formed implement, and speculation was rife as to how it came there. When found, the knife-

[1]Collins, J. W. "A curious knife found in the flesh of a codfish." *Bulletin*, United States Fish Commission for 1886, 1887, Vol. 6, pp. 381–83, figure.

blade was closed, and the small or posterior end of the handle was the part first felt by Captain Getchell, and was nearest the tail of the fish.

"The flesh of the fish where the knife was imbedded is estimated to have been 2½ inches thick. Unfortunately, the excitement attending the finding of the knife prevented any notice being taken of the fish, which was carried off and salted among the others; therefore nothing is known as to whether the implement was encysted or not.

"The handle of the knife is of brass, curved and tapering posteriorly, with a longitudinal incision, on the concave side, to receive the edge of the blade. The handle is remarkable in form, and is suggestive of the handiwork of some savage tribe or the scrimshaw work of a sailor. Its length, measured with the curve, is 3⅝ inches, and its greatest diameter one-half inch.

"The blade is lanceolate in form, with the cutting edge curved outward, to fit into the handle, and the back nearly straight. It has been corroded a good deal and the extreme point is very thin. Its length, from handle to tip, is 2¾ inches; greatest thickness (near the handle), one-eighteenth inch; and its greatest breadth a little less than one-half inch. The total length, from point to point in a straight line, is 6¼ inches.

"How did the knife get there? is the question that will be asked by those who are not too skeptical to credit the story of its being found as has just been stated. Personally, I neither doubt the finding of the knife, nor the probability of its being found as stated. It is a fairly common occurrence for fishermen to find the sand-launce, or lant, imbedded in the flesh or the liver of the cod, and dried very hard. I have many times see lant thus imbedded, and in no case that I remember was the cod any the worse for it. It is therefore evident that it is possible for the stomach of a cod to be penetrated by a sharp-nosed fish or by an implement it has swallowed, and ultimately for either to work its way through and become imbedded in the flesh, while the wound heals and the stomach goes on to perform its ordinary functions.

"As to where the fish got the knife we can only conjecture, unless some ethnologist can point out its origin. In any case, the finding of such a remarkable implement in such a strange place must be a matter of interest to the ethnologist and naturalist alike."

However, let us return to our sand eels, since they seem to be the *pièce de résistance* of the cod family. In 1885 W. H. Barrett[1] mentions the finding of a sand eel embedded in the liver of a haddock. It was four inches long and was firmly embedded, with its dorsal region toward the liver. The head and half an inch of the body lay in a groove formed by pressure in but were non-adherent to the liver. The other parts of the eel were, however, adherent to it. The little fish was partly covered over with white membrane, which in spots was apparently filled with cohesive matter. Because of this it was difficult to cut through the fish with a knife.

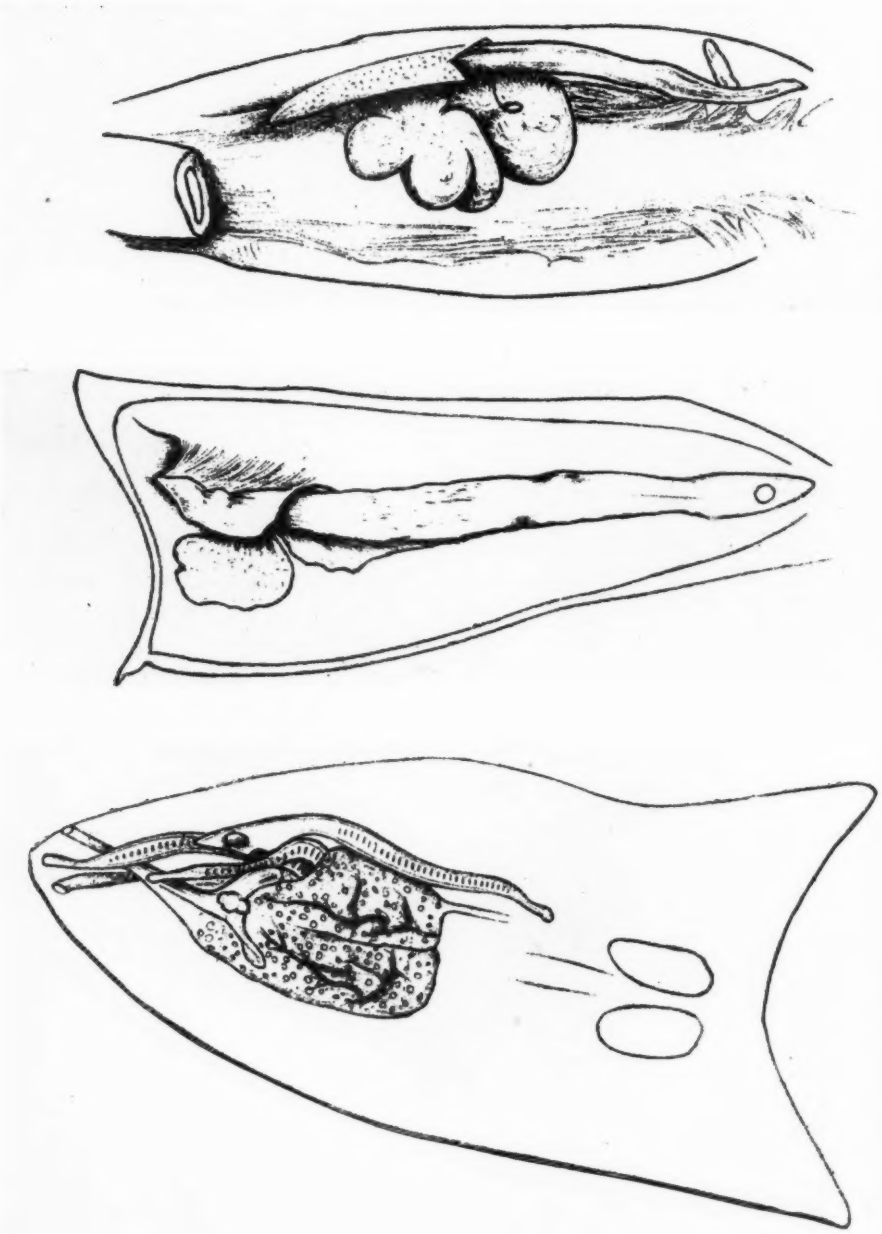
Barrett explains the penetration into the body cavity as follows. He notes that the sand eel penetrates the sand by using its sharp-pointed lower jaw as a wedge or drill. He thinks that the fish is swallowed head first and that head first it penetrates into one of the cæcal diverticula just below the stomach. It then bores with its jaw until its head penetrates into the body cavity, but if the cæcum is too small to let the larger shoulder region pass through, the fish is caught and held. However, the fish by vigorous wrigglings may tear the cæcum off and pass out into the body cavity of its host, where it would die surrounded by its cuirass of cæcum. Later, partly through pressure and partly as a result of inflammatory processes, it would become embedded in and adherent to the liver.

The most extensive series of observations of the phenomenon ever made, illustrated by the only figures known (save that of the knife and my own of the backbone) we owe to H. C. Williamson,[2] who published so lately as 1911. According to his records, also, sand eels were the chief offenders and the number of instances of their penetrating into the body cavity of their devourers was eight in all. Speaking of these cases in general, he says:

"The sand-eels, after being swallowed by the fish, have escaped from the gut and passed into the abdominal cavity. There they have generally damaged the liver before they died. Sometimes they are found with the head or tail jammed tightly into the space between the reproductive organ and the peritoneum. They are covered with a material which resembles a hardened paste, and in some cases they are in part enclosed in a skin of connective tissue derived from the peritoneum. In this way they are reduced to a mummified condition. . . . One large sand-eel was commonly found in the

[1]Barrett, W. H. "Note on the liver of a haddock in which a sand-eel was partly embedded." *Third Annual Report, Fishery Board for Scotland*, for 1884, 1885, Appendix F. No. V, pp. 70–2. 3 figs.

[2]Williamson, H. C. "Sand-eels (*Ammodytes sp.*) and a Hermit-Crab (*Eupagurus bernhardus*) encysted in the abdominal cavity of the Haddock (*Gadus æglefinus*), Cod (*Gadus callarias*), and saithe (*Gadus virens*)." *28th Annual Report*, Fishery Board for Scotland, Part III—Scientific Investigations—1911, pp. 62–3. 6 figures.



SAND EELS EMBEDDED IN THEIR DEVOURERS

It sometimes happens that, in defiance of the laws of digestion, an object swallowed by a fish, instead of passing through the alimentary canal, will work its way into the abdominal cavity, remaining there permanently, without undergoing decay itself and without necessarily causing vital injury to the fish. Among the objects swallowed as food that are most apt to behave in this perverse fashion are sand eels. In the upper and middle pictures are seen the long, thin bodies of two of these eels attached respectively to internal organs of the cod and of the haddock. The lowest picture reveals no less than three sand eels assembled in the abdominal cavity of a haddock. After Williamson

cavity, but in one case three small sand-eels were present."

Some of Williamson's clearer figures are reproduced herewith, together with the gist of his remarks concerning each case. Three cases are not figured, but of them he says:

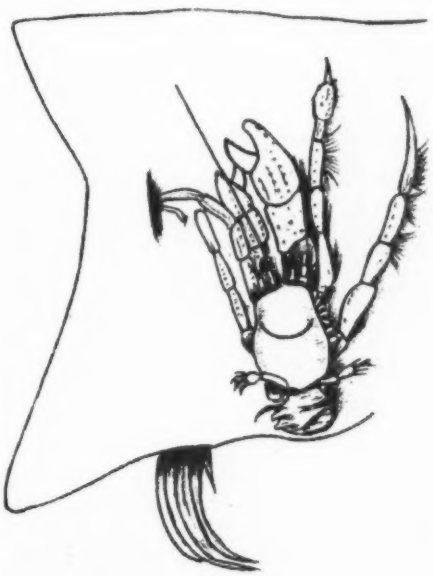
"A large sand-eel, $7\frac{3}{4}$ inches in length, was lying along the dorsal region of the abdominal cavity of a codling. It was thickly plastered with hardened paste. Its tail was twisted round the urinary bladder. The skin of the liver, which had evidently been destroyed, was attached to the peritoneum as a thickened wall along the ventral part of the abdomen.

"Another codling had a very small sand-eel, $2\frac{3}{8}$ inches long, coiled up at the anterior end of the abdominal cavity. The anterior third of the fish was buried in the liver, and the liver had grown attached to the peritoneum. A sand-eel was discovered in one saithe. It was adhering to the abdominal wall."

Now we come to the last, and, taking all things into consideration, the most remarkable case of an embedded body ever recorded. Those previously described, including the knife, are pointed bodies, which one might expect would under favorable conditions penetrate the walls of the stomach or of the intestine and pass into the abdominal cavity. But the intrusive animal to which attention is now called is bulky and, furthermore, is provided with five pairs of sharp-pointed legs that are capable of offering opposition. The case in point is that of a hermit crab, which, probably finding that it had outgrown its quarters in some marine snail shell, had left its safe home to seek new quarters, and while on this unprotected quest had been spied by a wandering codfish, pounced upon, and swallowed whole. However, it revenged itself in true melodramatic fashion by penetrating the wall of the stomach and passing into the body cavity where it became transformed into a mummy, surely to the great discomfort of its former captor and present host.

Williamson agrees with Barrett that the sand eel might without great difficulty penetrate the walls of the stomach, cæcum, or intestine, and thus get into the cavity of the abdomen, but that this could not have been the process by which the crab passed, he is sure. The crab, he thinks, must have passed through the wall of the stomach at a point where the tissue was weakened, possibly to some degree by the attacks of some intestinal parasite, such parasites being found only too frequently in fishes.

Some occurrences of intrusive bodies, such as those of pipefish and sand eels, in the body cavity are fairly easily explained, and even the presence of the hermit crab can be understood. Not so clear, however, is the presence of the spinal column which I found in the abdominal cavity of the barracuda; and I am entirely at a loss to explain how the knife made its entry and how the skeletons noted by Vinal Edwards could have penetrated into the great muscle of the back of the fishes in which they were found. Careful dissections of such specimens by a trained anatomist might show traces of the manner of penetration. Until such an opportunity offers itself, the matter must remain more or less of a mystery.



A hermit crab adhering to the internal surface of the abdominal wall of a cod. How this crustacean, with its stretch of three inches, and its sharp-pointed legs and ponderous claws, was able to make its way into the body cavity is as hard to explain as the fact that a fish subjected to such rough treatment internally should have escaped mortal injury. After Williamson

A fossil stump of *Psaronius* recently presented to the American Museum by the New York City Board of Water Supply. *Psaronius* is among the oldest "trees" of which we have evidence, antedating by millions of years the appearance on this earth of the plants of the Coal Period, the great reptiles, and the early mammals, which are so vastly remote when viewed from the standpoint of human experience of time

A TREE FERN OF MIDDLE DEVONIAN TIME

BY

EDMUND OTIS HOVEY*

PLANT life of some kind must have flourished on the continents and islands of very early geological time, but the plants themselves did not contain woody tissue enough for preservation in the fossil state, nor were other conditions favorable for such preservation. It is not until the Hamilton Period of Middle Devonian time that evidences of land vegetation become abundant, and even then the verdure which, it may be assumed, covered the hillsides, disappeared entirely when it died. Lycopods, ferns,

*Curator of Geology and Invertebrate Palæontology.

horsetails, or scouring rushes, and the like—plants which love the damp spots of the land—are the only forms which the luxuriance of the old tropical or subtropical forest. Flowers were absent, but the foliage must have been beautiful.

The American Museum is indebted also to the New York City Board of Water Supply for several sizable fragments of rock on which the leaves of the tree fern *Psaronius* left their fossil record to be read and interpreted æons later by man. One of these slabs of rock, with the ribbon-like leaves broadly distributed over its surface, is reproduced herewith

have been fossilized, with the result that their remains have come down to us.

The oldest "trees" known in the world are, accordingly, the gigantic tree ferns of the Hamilton Period of Middle Devonian time. They flourished in the swamps of the regions now known as central New York State and Ohio, as well as elsewhere, and they grew to enormous size, trunks four feet in diameter having been found. The eminent Canadian geologist, Sir J. William Dawson, devoted much study to these forms of plant life, and he gave them the name *Psaronius Erianus*.

In those days of long ago the climate of central New York must have been warmer and more moist than it is at present, and we may picture to ourselves The leaves of *Psaronius* were, apparently, ribbon-like in character and rose in a graceful tuft from the short stump. There was no high bole to the tree and it had no branches.

One of the features of the comprehensive plan for using the water resources of the Catskills to furnish an adequate supply of good water to the city of New York is the diversion of the upper portion of Schoharie Creek into the Ashokan Reservoir. In carrying out this project the engineers of the New York City Board of Water Supply are constructing a massive concrete and masonry dam at the little village of Gilboa, Schoharie County, and to secure stone for facing have opened a quarry in the Hamilton sandstone down stream from the site

of the dam. In this quarry they have come upon a bed sixty feet below the horizon at which the original Gilboa tree stumps were found, and in this bed they discovered several perfect and nearly perfect stumps of tree ferns resting upon a bed of shale marking the level of the ancient swamp. From this series a stump thirty-two inches in diameter and about two feet high was selected and presented to the American Museum by the New York City Board of Water Supply. This beautiful stump and some of the ribbon-like leaves from the associated sandstone have been installed in the Devonian case in the hall of geology and invertebrate palæontology on the fourth floor of the Museum.

Photograph by E. O. Hovey

Quarry in the Hamilton Sandstone at Gilboa, New York. The stumps of the giant tree fern *Psaronius* were found upon a thin bed of shale exposed at the bottom of the quarry face

A COLLEGE COURSE IN ZOÖLOGY*

BY

HAROLD H. PLOUGH[1]

THE profound effect which the development of modern biology has had both in the field of ideas, and in medicine and public health, has resulted in widespread recognition of the fact that an acquaintance with this science in its broad outlines has an essential place in any scheme of liberal education. In many institutions it is the first course in zoölogy which has been called on to supply this general knowledge. The greatly increased enrollment in such a course—an enrollment which in certain of our larger universities has passed the five hundred mark—is clear evidence that the subject is making a wider appeal. Such a course is no longer primarily an introductory course for students who are beginning their training in some special field. It is rather a cultural course for those who have no thought of specializing, but who wish to understand something of the results of biological research because of their intrinsic importance and their relation to the broader problems of human living. This gradual change in purpose has made the first course in zoölogy very much more interesting and suggestive to the layman with little knowledge of natural history than it was formerly. The emphasis has come to be placed on the broad principles which biological research has established or is opening up, and less on the practical training designed as a foundation for the special student of biology. It is probable that such a course, even though it may sacrifice much necessary detail, will prove in the end to have been the better approach to the subject not only in the case of the general but also of the special student.

Within the last year or two much discussion has arisen among college teachers and other professional biological workers as to the best method of presenting the newer type of general course. The older course, standardized by Huxley and still the basis of most of our zoölogical textbooks, was mainly morphological. It carried the student through a more or less detailed laboratory study of a typical specimen of each of the important groups of animals, with some incidental discussion of their evolutionary connections and their relation to man. As a result of the trend now in progress, the opposite extreme has been reached in the course outlined in the textbook entitled *Principles of Animal Biology* by Professor A. F. Shull, of the University of Michigan (McGraw-Hill Book Company, New York City). The course outlined completely abandons the older method and arranges its facts about certain rather artificial subdivisions of the subject similar to those groups in which the various research workers in the biological field find themselves aligned. Thus we have sections devoted to morphology, physiology, embryology, geographical distribution, taxonomy, etc. This method of treatment by no means abandons the first-hand laboratory study which is perhaps the most important and distinctive feature of any elementary course in science. It merely groups laboratory dissections and experiments so that they bear strictly on the principles under discussion. As given by Professor Shull, with the collaboration of other members of the department at Michigan, the method is found to be successful in attaining the objects already stated.

To many teachers, however, this development appears to have overshot the mark. After all, the basic facts of biol-

*A review of *Zoölogy—A Textbook for Colleges and Universities*, by T. D. A. Cockerell, Professor of Zoölogy, University of Colorado.

[1]Associate Professor of Biology, Amherst College.

ogy are morphological, or at least deal with the interaction of form and function. Embryologist, physiologist, geneticist, and student of evolution, are investigating different sets of facts relative to the complete animal, and without a knowledge of animal structure the significance of their work is lost. In attempting to satisfy the increased emphasis on the broad principles of the science, there is danger of obscuring the root of the principles themselves. No discussion of biological conclusions can be of great value to a student unless he has a certain minimum of knowledge of the morphology of representative animals. For some such reasons teachers more commonly retain the elements of the older method while completely shifting the emphasis—that is, a certain number of animal types are investigated in some detail, and with this knowledge as a foundation discussions and experiments are added which bring out clearly the broader conclusions deduced from modern research.

For such a course a textbook is not an essential requirement. Huxley always advised elementary students not to use one, but to get their knowledge from their own observation in the laboratory and the supplementary description and discussion given by the teacher. While this is certainly sound with respect to the individual work in the laboratory, there are few students who are not aided by a concise running account of the principles under discussion. It is true also that few instructors find it possible to give adequate emphasis to all lines of biological investigation. These deficiencies a textbook can supply. It should not be a substitute for the teacher nor for the observations of the individual student. It can supplement both by giving added unity and interest.

A new textbook which has such a purpose in view, and which meets the newer point of view of the general course is *Zoölogy* by Professor T. D. A. Cockerell, of the University of Colorado (World Book Company, Chicago and Yonkers, N. Y.). Professor Cockerell has carried on productive research in many biological fields, and that fact gives him peculiar fitness for the task of preparing a textbook of this kind. His book follows the standard treatment to the extent of giving a brief account of the successive groups of animals, but it omits the usual detailed anatomical descriptions, thus placing the responsibility for careful laboratory observation of structural details entirely on the student. The theoretical chapters dealing with established biological principles and the results of current research on important problems are scattered throughout the book. These discussions are for the most part complete in themselves, so that teachers who vary the order may do so without causing difficulties in the context. A valuable innovation is the addition at intervals of short, interesting biographical chapters describing the life and work of a number of world-famous biologists, as well as one or two who, like Agassiz, were noted mainly for their part in establishing the science in America. The book has now been out for over a year, and promises a considerable term of usefulness in colleges and universities. For many who are not students, it may prove of value as a readable and accurate summary of the more important facts which make up modern zoölogy.

The first quarter of the book is general in character. The fundamental characteristics of all organisms are discussed in short chapters dealing with the cell and its activities, tissue structure, and cell physiology. The subject of heredity is then introduced with an account of the life of Mendel and a statement of the laws of inheritance which bear his name. The particulate scheme of inheritance, the working out of which has been the most striking achievement of biological science in the past twenty years, is illustrated by the breeding results in the sunflower. The red variety,

which was first noticed in 1910, has been the subject of investigation by Professor Cockerell. Its breeding behavior in crosses is a clear-cut example of inheritance according to the Mendelian scheme. The discussion naturally passes to the bearers of the hereditary units, the chromosomes, and the behavior of these all-important nuclear structures is described in relation to fertilization and sex. The facts of heredity afford a solid foundation on which a consideration of organic evolution may be based, and this is the next topic treated. After a short sketch of the life and work of Darwin, his theory of evolution by natural selection is outlined, and a critical survey of the kinds of variation in organisms and their origin is given. The more strictly theoretical part of the book ends with a summary of the geological history of the earth, a discussion of the succession of animals and plants, and an interesting chapter, illustrative of fossil forms of life in general, describing the animal and plant remains found by Professor Cockerell in the Florissant shales of Colorado.

The book is unique among similar volumes in that the descriptive portion is interesting reading, a fact which adds greatly to its usefulness. This is due largely to the fact that there are no detailed morphological descriptions of typical specimens. Instead we find short accounts of the general plan of structure in the more important subdivisions under each phylum, together with a statement of the probable evolutionary relationships, and any interesting points in the natural history of individual species. Whatever the method or the material used by the individual teacher, the treatment in this section will, it may be assumed, add to the interest in addition to providing all that is usually needed in the way of reference matter. Many courses in zoölogy make no attempt to arouse interest in natural history and the observation of animals in their natural environment. Most students of college age are responsive to suggestions directed to that end, and a textbook which makes an attempt to awaken such an interest forms a valuable supplement to a course of any type. A representative instance of this is found in the treatment of the insects. After a general survey of the whole group, three short chapters are devoted to the Lepidoptera, bees, and ants, respectively; and a fourth describes the life and work of J. H. Fabre. The illustrations throughout this section are photographs from life, and are an effective aid in stimulating an interest in the study of the living animals.

The remainder of the book consists of an application of the knowledge already gained to specific problems of general interest. After a brief account of the evolutionary history of the horse and the elephant, the evolution of man is discussed and a brief anthropological sketch given. Other evolutionary problems, such as the geographical distribution of life, the characteristics of life in the tropics and in the circumpolar regions, the types of life in the sea, all receive attention. Finally certain applications of biological principles to human society are suggested. An account of the life and work of Pasteur introduces the subject of infectious disease, and thus the general question of public health is opened up. In a short consideration of history from the biological point of view the influence of disease on human evolution—a point too seldom raised—is emphasized. The general conclusions of the study of heredity are applied to the human species and the possibilities of eugenics are touched on. The book closes with an attempt to sum up and evaluate the biological contribution toward a philosophy of life.

Taken as a whole Professor Cockerell's textbook fulfills its purpose admirably. Within a volume of reasonable size it presents the important biological ideas to the general student in an interesting and thoroughly coherent manner. As a text book it may be used as the groundwork

for a general course regardless of the individual treatment of the teacher. More advanced students who wish a review of the whole field will find it well worth reading. One real omission is all reference to the process of development in animals. Even though this furnishes the subject matter of a separate course, some discussion of it should fall in the course for general students. Teachers can easily supply this lack in class or laboratory demonstrations. Apart from this the book meets the needs of the newer general course with marked success.

TO THE NEW-BORN SON OF A NATURALIST

You will see, where we are blind,
We may seek, but you will find;
Yet when you hold the golden thread
Passed on from days of long ago,
The names of those rememberéd
For what they strove to do and know
May still have power to stir the mind,
And passing, leave a gift behind!

—T. D. A. COCKERELL.

THREE INTERESTING BIRDS OF THE COLORADO MOUNTAINS

PHOTOGRAPHED IN THE WILD STATE

BY

CLARK BLICKENSDERFER

THE ROCKY MOUNTAIN JAY, OR CAMP BIRD

The Rocky Mountain jay or camp bird, long-crested jay, and Clarke crow are probably the three most conspicuous birds to be seen on a trip into the Rocky Mountains of Colorado.

The Rocky Mountain jay is well known to every camper who has pitched his tent in the deep, coniferous forests of the higher mountains. Hardly has the camp fire been lighted and the bacon begun to fry, when the Rocky Mountain jay with a low, plaintive cry, and a quick, quiet flutter of wings, is seen perched on a near-by branch watching one's every movement with keenest interest. If you are kindly disposed and toss him a piece of bread, he seizes it in an instant, and flies off with it through the forest, only to return for more, accompanied by others of his tribe

THE LONG-CRESTED JAY

The long-crested jay, with its well-groomed, dark blue coat, high topknot, and white markings on the forehead and above the eyes, is constantly encountered from the foothills to timber line. Not satisfied with its rather conspicuous form and color, it forces attention by always squawking and scolding, as it moves about under the pine trees or soars away over a low rise.

Every mountain ranch has its jay visitors, that especially delight in the chicken yard and take every opportunity to get an easy meal of chicken feed, flying into the nearest trees upon the approach of the farmer and scolding him noisily. When near a human being, these birds are always on the alert, and very reluctant to make friends; often without the slightest warning, seeming to scent some kind of danger, they will make a quick jump and take to wing with amazing speed

THE CLARKE CROW OR NUTCRACKER

This is a larger bird than the jays, with light gray head, neck, and back, and wings and tail of black, with a few feathers of pure white. A casual observer would never take these birds for crows, their heavy, black bills being their only marked resemblance to the bird of sable plumage. They are seen most often in scattered flocks, when moving to or from the foothills, where they winter, to the high, thickly forested mountain slopes, where they spend the summer, feeding as they go upon clusters of pine cones. Using their large bills, they strike the cones with great force, tearing them open and obtaining the pine nuts within. When these have been extracted, the cone is dropped and falls clattering through the branches to the ground. The noise of the dropping cones is often the first warning that one has of the presence of the birds in the trees above him.

The Clarke crow is seldom attracted to the abodes of men, but is a frequent visitor to the garbage piles of permanently located graders' camps in the high altitudes, where it is the monarch of all it surveys and even the audacious camp bird has to retreat while the Clarke crow takes its pick of the food spread out before it

Molocca or communal house.—All the Indians of a community live in one house, each family having its allotted space around the sides. The central part is used for meetings, dances, games, etc. Often there is not another molocco within 100 miles, and the rivers are the only roads

TAPIOCA—A FAMILIAR FOOD OF UNFAMILIAR ORIGIN

BY

CHARLES W. MEAD*

SOME three years ago I installed an exhibit in the Peruvian hall of the American Museum, showing how the Indians of northern South America make tapioca, their staple food. This step was taken as a part of the Museum's educational work, after I had asked quite a number of school children whether they could tell me of what tapioca is made, and had been answered either that they did not know or that it came from a palm tree.

This ignorance is not confined to children, for during the time this exhibit has been in the Museum I have not met more than half a dozen adult visitors who knew that tapioca was made from the tuberous root of the cassava plant. Two species of cassava are cultivated: the bitter cassava, *Manihot utilissima*, Linn. and the sweet cassava, *Manihot dulcis* var. *Aipi Pax*. The first, the more useful of the two, contains hydrocyanic acid and cannot be eaten in its natural state, but its nocuous qualities are quickly dissipated by heat. This is the variety from which tapioca is made. The sweet variety is innocuous and is used as a table vegetable. Both the bitter and the sweet cassava had their origin in tropical South America. The former has been introducd into many tropical countries and is very extensively cultivated in the western part of tropical Africa and in the Malay Archipelago. Its starch, in the form of tapioca, is a staple export from these regions as well as from Brazil and other South American countries. This starch is sold also under the name of Brazilian arrowroot. The roots are sometimes sliced, dried, and grated, to be made into cassava bread.

The juice expressed from the poisonous cassava is converted into a beverage

*Assistant Curator of Peruvian Archæology, American Museum

Tipiti, or press, in position.—In some localities a device is used by means of which tension is maintained on the press without having someone sit on the end of the pole. The greater the length of the pole the more is the tension exerted on the press

Large earthen platter upon which tapioca is cooked, and to the right on its tripod the sieve with a basket cover

On the left is the basket used by the women in bringing the cassava roots from the field. When in use these burden-baskets rest on the woman's back; the supporting strap passes across the woman's forehead. In the middle picture is shown a cassava grater of wood with imbedded pebbles. The sieve on the right is woven of fine strips of cane

by heating and fermentation, and by evaporation and concentration, with the addition of various aromatics, it becomes *Cassareep*, the favorite condiment of the South American Indians. *Cassareep* is imported in considerable quantities into Holland and Britain. It is the basis of the favorite West Indian dish called pepper pot.

The objects in the exhibit showing how the Indians make tapioca are a part of the results of an expedition under Messrs. Herman Schmidt and A. Weiss that was sent by the Museum to the region of the western tributaries of the Rio Negro in Colombia. The photographs show some of these objects in position, just as the Indians were found using them on the banks of the Rio Caiary-Uaupes.

The Indian woman takes a large piece of cassava root in both hands and rubs it back and forth on a board studded with hundreds of sharp pebbles until the root is reduced to pulp. When a sufficient quantity has been grated, the next step is to press as much water out of it as possible. For this purpose a long, narrow tube of basketwork, called a *tipiti*, is used. This basketwork press has a loop at either end. The pulp is forced into the press, which is then hung up by one of the loops. Through the lower loop is inserted a long, stout pole which in turn is run under some convenient object that serves as a fulcrum. The woman thereupon sits on the free end of the pole, her weight stretching out the press and forcing the liquid through the interstices of the basketwork. This liquid is caught in a pottery vessel and is then prepared in the manner stated above.

The wet mass is taken from the press and spread on a very large flat dish of pottery having a raised rim, under which a fire is built. If stirred rapidly, the preparation is prevented from caking into large masses, and quickly agglomerates into small, irregular pellets, the tapioca of commerce.

The *tipiti*, a basketwork press, is from five to eight feet long and is made of strands of palm leaf

NOTES

THIRD ASIATIC EXPEDITION

PROFESSOR OSBORN TO VISIT THE FAR EAST. President Henry Fairfield Osborn of the American Museum is on his way to the Pacific coast to board a steamer for the Far East. He will disembark at Yokohama and visit various localities in Japan. Thence he will cross to the Asiatic mainland and travel by rail through Corea to Peking, his principal destination. There he will be met by Mr. Roy Chapman Andrews and the other members of the Third Asiatic Expedition, who will at the time of his arrival have emerged from the Gobi Desert. Of such far-reaching importance are the discoveries which have been made by the expedition to Mongolia that the presence of Professor Osborn was particularly desired to the end that the plans for the future work in this area and other parts of Asia might be discussed in the light of his wide experience. Professor Osborn will himself make a personal inspection of the fossil beds in the desert of Gobi in company with members of the expedition. It is Professor Osborn's plan to go from Peking to the Siwalik Hill region of India to visit, together with Mr. Barnum Brown, some of the important palæontological areas in that region.

BIRDS

BIRD STUDY ON THE WEST COAST OF SOUTH AMERICA.—Dr. Frank M. Chapman, curator of the department of birds, American Museum, writes from Guayaquil, Ecuador, July 26, 1922, of the successful prosecution of ornithological work in the Chongon Hills, west of the River Guayas, and also among the islands, shore lines, and estuaries of the Gulf of Guayaquil. It had been the intention of Doctor Chapman, together with his associates George K. Cherrie and Geoffrey O'Connell, to travel by boat from the Gulf southward along the Peruvian coast to Payta, in order to make investigations in a region which is of particular interest, because it is on the border line between the humid tropics and the rainless Peruvian littoral. The bird fauna of the equatorial Pacific, west of South America, is decidedly different from that of the Humboldt Current region, which extends northward to the neighborhood of Point Pariña, the westernmost projection of the continent. The divisions between these two faunal regions had, however, been very slightly known for lack of intensive field work. One of the principal objectives of Doctor Chapman's trip was the island of Santa Clara, or Amortajada ("shrouded corpse"), which lies off the estuary of the River Guayas, southwest of Puna Island.

Doctor Chapman's letter states that he could find no suitable vessel for the long trip to Payta, and so when by chance an opportunity came to hire a launch for the shorter voyage to Santa Clara he availed himself of it. Leaving Guayaquil at night, the party reached Santa Clara next day but found the ocean too rough to permit of landing. There proved to be no harbor at Santa Clara, and there was no lee in the prevailing wind, while a dangerous reef could be seen a short distance to leeward of their anchorage. With a gradually increasing wind, the launch bearing the American Museum's representatives lay about 200 feet from the island in a surging sea which forced Doctor Chapman to give up his attempt to land. He then planned to go over to the Peruvian mainland, above Tumbez, but the cross sea in the gulf was too much for a launch and he finally had to run before the wind into Puna. The same night he made another attempt to get across but was once more obliged to give up after the boat nearly turned turtle.

Doctor Chapman writes that although they could not land on Santa Clara, the island, which had not previously been visited by a naturalist, has at least been put upon the ornithological map. It is a vertical rock, from 100 to 200 feet high, extremely barren with no vegetation other than scrubby bushes; it appeared not to be a likely place for land birds. Boobies, man-of-war birds, and brown pelicans evidently constituted the resident bird fauna. None of these seemed to be breeding at the time of the visit; indeed, all specimens taken on land or water were in full post-nuptial molt.

Later, the Museum's party covered both shores of the Gulf of Guayaquil, and ran up many stream courses and coves, gaining an adequate idea of the whole region. Aside from observations and photographs, they obtained many skins, adding fifteen species to the recorded avifauna of Ecuador. A particularly interesting discovery was the presence in large numbers of North American shore birds in midsummer (early July); these included Hudsonian curlews, dowitchers, black-bellied plover, and a flock of no less than 300 willet.

Doctor Chapman found the gulf climate delightful, with very few mosquitoes, and little rain. Temperature observations showed that the ocean water ranges close to 74° F., or more than 12° higher than the temperature of the Peruvian shore waters, but a short distance south of Point Pariña.

AN EXTINCT PARROT ACQUIRED BY THE AMERICAN MUSEUM.—Through the generous gift of Mr. J. Sanford Barnes, of New York City, the American Museum of Natural History has been enabled to purchase from the Zoölogical Museum of Vienna, a specimen of an extinct parrot known to science as *Nestor productus*. Only

thirteen specimens of this species are to be found in all the museums of the world. The home of the *Nestor productus* was at Norfolk Island, which lies in the Pacific Ocean, several hundreds of miles east of Australia and north and west of New Zealand. The species seems to have lived both upon Norfolk Island and upon a small outlying islet known as Philip Island All the parrots upon the main island were exterminated by convicts and settlers in the early part of the nineteenth century, and it is thought that every specimen now in existence came from Philip Island, where the species survived until a somewhat later date. Under these circumstances, it is not absolutely certain that the Norfolk Island parrot was identical with that of Philip Island, but upon the basis of the early descriptions it is generally assumed that the two were the same. Lord Howe Island, which lies somewhat north and west of Norfolk Island, also had a native species of *Nestor*, which has likewise been exterminated.

The parrots of the genus *Nestor* are confined entirely to the New Zealand region, and two species, known by the native names of "kaka" and "kea" still exist in small numbers in New Zealand itself. The kea of the Maories, *Nestor notabilis*, lives in the higher mountain ranges of the South Island and has been nearly exterminated by the inhabitants because it has developed an extraordinary habit of attacking sheep, picking holes through their backs and sides with its powerful beak, so as to obtain the fat surrounding the kidneys. In the National Museum at Washington, mounted specimens are shown in the act of thus lacerating a sheep. It has been inferred that the parrots first acquired this curious habit through tasting the fat of sheep carcasses hung up after dressing, but it is probable that the accounts of their ravages on sheep have been considerably exaggerated. The normal food of all the parrots of the group consists of fruit, seeds, and the larvæ of wood-boring insects, the last being obtained by stripping the bark from trees. The parrots of Norfolk Island and of Philip Island were, of course, exterminated so long ago that they had no opportunity to acquire such undesirable habits as those evinced by the New Zealand kea.

The specimen now in the American Museum is about the size of a crow and has a characteristic long, sharp, hooked bill. Its body plumage is greenish gray, with orange or reddish cheek patches and a wide yellow breast band. Its head was figured in color by Lord Walter Rothschild in his monographic volume on *Extinct Birds* (1907). The specimen was originally bought by the Vienna Museum in 1839, thirty years before the founding of the American Museum of Natural History, from Ward, the London dealer. Through the generosity of Mr. Barnes it has now come to what is hoped will be its permanent home. R. C. M.

AUSTRALIA

PROGRESS OF THE AMERICAN MUSEUM'S EXPEDITION.—Mr. H. C. Raven, the field representative of the American Museum in Australia, has recently made his way out of northern Queensland with what is described by the director of one of the Australian museums as "a very fine series of mammals in splendid condition." The material secured by Mr. Raven in the field has been augmented by exchanges, including not only mammals but other classes of animals. Mr. Raven is now collecting in the Burnett District in company with Mr. Colclough of the Queensland Museum. The generous spirit of coöperation shown by sister institutions in Australia has contributed in no small measure to the success of the expedition of the American Museum in that continent.

AN AIR-BREATHING WATER SPIDER

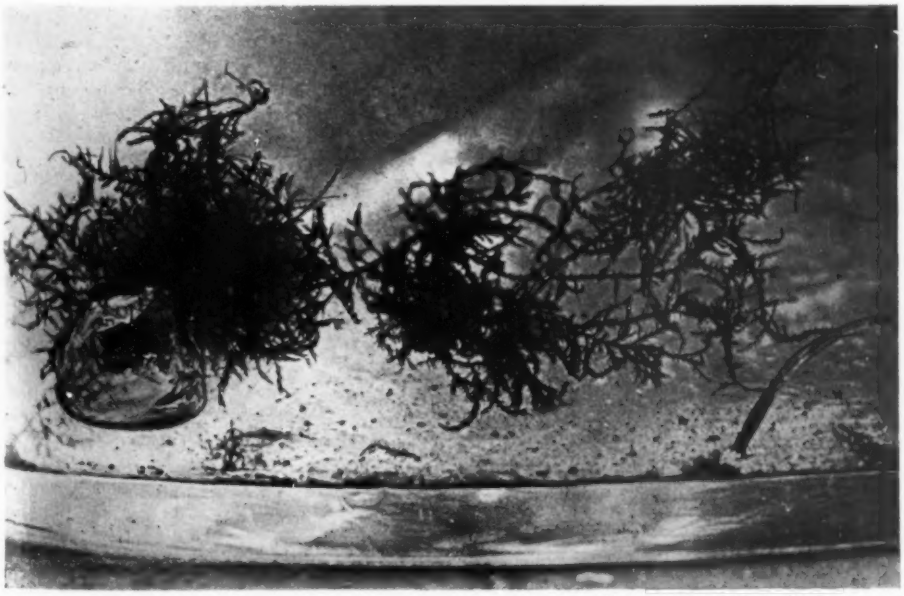
ALTHOUGH the spider fauna of America includes spiders more or less aquatic in their habits, like *Dolomedes*, it lacks the interesting *Argyroneta*, an air-breathing water spider that is present in Europe as well as in north and central Asia. Mr. F. H. Haines has on more than one occasion in the past kindly shipped to the American Museum specimens of this genus collected in England. The long sea voyage, during which the spiders have been confined within a tin box, has necessarily taken a heavy toll of life and the survivors have sometimes been slow to demonstrate their interesting habits. Of twelve *Argyroneta* contained in a recent shipment from Mr. Haines, six were sufficiently hardy to weather the abrupt change in their mode of living and the discomforts of an ocean voyage and reached the Museum without any pronounced loss of vitality.

The spiders were at once transferred from the tin container in which they had made the trip to a water-filled bowl, and one of them promptly celebrated its liberation by an act of cannibalism. Thereupon the precaution was taken of placing the five survivors in as many bowls, each provided with a small cork raft and some submerged plant material.

One of the specimens began almost immediately the construction of its under-water rest-chamber, a more or less ellipsoidal or dome-shaped enclosure of spider silk fastened to some water plant or other subaqueous support and filled with air that the spider brings down to it by repeated visits to the surface of the water. It was a fascinating sight to watch the spider as it worked, swimming upwards until it could thrust the tip of its abdomen out of the water and then reimmersing it immediately to return below, its body silvered by the air bubble held imprisoned in the long abdominal hairs. This bubble was released under the structure of silk

Photograph by A. Katherine Berger

The air-breathing water spider, *Argyroneta aquatica*, is seen resting in inverted position near the bottom of the glass container, its abdomen aglisten with the quicksilver-like air bubble that enables it to breathe under water. Some distance above the spider and to the left is the oval-shaped rest chamber in process of construction



Photograph by A. Katherine Berger

A completed chamber, in which the spider, her task of building ended, is enjoying a well-merited rest

and with other bubbles successively added, ballooned out the tightly spun fabric until it resembled a miniature parachute. After depositing its bubble, the spider worked with its third and fourth pairs of legs, while apparently engaged in strengthening or enlarging its dome-shaped dwelling.

Stabley in *British Spiders* states that from her domicile *Argyroneta* "extends cords in various directions, which she attaches to the leaves and stalks of plants and to other objects." One of the objects used for anchorage in the present instance was the cork raft that floated on the surface of the water. To one of the edges of this raft the spider attached a taut, well-nigh vertical strand of silk along which she made her ascents and descents. When she had constructed a commodious cell and made her ascent for what at the time was believed to be her last visit to the surface, she ruptured this strand near the top and in descending rapidly to her rest chamber, disposed of the strand completely. She then entered her enclosure and holding with her front legs to its sides, worked hard with her third and fourth pairs of legs, presumably putting the finishing touches upon the architecture.

After being engaged in this way for some minutes she rested, becoming, in fact, totally inert. She remained motionless for twenty minutes and as the act of building seemed definitely at an end and the hour was getting late, observations were abandoned. Great was the surprise, therefore, when on the morrow it was noted that in the interval she had enlarged her air chamber by at least a third, and, what was equally interesting, she had replaced the broken strand by another.

As the days went by several of the other spiders built retreats. Sometimes these were placed against the glass of the aquarium, as shown in the lower picture on p. 473, at other times they were constructed in the submerged plant material as indicated in the upper picture on the same page; not infrequently they were built on the underside of the frail rafts of cork.

On the morning after the arrival of the spiders a fly was caught and thrown into one of the bowls. At first the spider thus favored seemed rather indifferent to the insect that was skating frantically about the surface of the water. Then she seized it and holding it tightly in her jaws, swam below and placed it against a water plant, while she went to inspect her cell. For some reason the structure failed to win her approval and accordingly she proceeded to build a new banquet hall. When this had attained satisfactory proportions, she swam over to the fly and with much labor—for the fly was a bluebottle and much larger than its captor—bore it into the chamber prepared for its reception.

The cell had been constructed beneath the raft. In the afternoon the wind that blew through an open window caused miniature waves in the bowl and these, in turn, disarranged the raft with the resulting partial collapse of the cell. Thereupon the spider, deciding perhaps that all the titbits of the fly had been consumed and that what remained was not worth her efforts, removed the fly and swam with it a considerable distance through the water. The fly had been partly dismembered; one of the wings was torn off and some of the legs were detached.

Later in the day another fly was placed in the same bowl and after a short interval was attacked by the spider, which seized the insect by the fore part of the body and carried it to her cell. Again the wind proved a disturbing element, resulting in this case in the complete collapse of the cell. Just prior to this catastrophe the spider had gone to the surface to bring down an air bubble for the purpose of enlarging her domicile. On descending to the scene of the disaster she seemed much mystified to find nothing but sodden cobweb where before was a well-proportioned building. She took her fly and swam around in a distracted manner for some time. Then she approached the edge of the raft from below and obtaining a precarious foothold for two or three of her flexible appendages, tried desperately to lift herself and her burden out of the water. Failing in the attempt, she thereupon built a new cell to accommodate the prey.

Another spider, having longer legs which offered better leverage, succeeded in lifting her fly upon a raft and proceeded to suck the juices.

On many occasions the spiders exhibited their interesting building habits, and in watching them it was hard to decide which was the more wonderful,—the device whereby nature has enabled these little air-breathing creatures to escape drowning when they submerge themselves for long periods, or the fact that they should choose such a strange medium as water in which to build their silken-roofed homes.

INSECTS

Recent Field Work on Insects.—Dr. F. E. Lutz, curator of entomology, American Museum, spent the summer in the vicinity of Boulder, Colorado, continuing the field work which he has been doing in connection with the wild bees of Colorado and carrying on investigations as chairman of the National Research Council's Committee on the Biological Relations between Flowers and Insects. On the return trip Professor T. D. A. Cockerell, of the University of Colorado, accompanied him as far as Lincoln, Nebraska, in the field-automobile of the department of entomology. Short stops were made for collecting with the result that seven species—two new to science—were added

to their manuscript list of about eight hundred different kinds of wild bees in Colorado.

FISHES

THE "BIBLIOGRAPHY OF FISHES."—The monumental *Bibliography of Fishes*, a work inaugurated in the American Museum many years ago under the inspiration of Curator Bashford Dean, is now nearing completion. Doctor Dean himself devoted many years to this bibliography; it was taken up with enthusiasm and devotion by Dr. Charles Eastman, formerly of Harvard University, and a learned student of the fishes. On the lamented death of Doctor Eastman, Doctor Dean invited Professor E. W. Gudger, of North Carolina College for Women, to continue this important work. The first volume of titles was brought to a close in 1916 and the second volume in 1917, the printing being admirably done for the Museum by the University Press of Cambridge, Massachusetts. Since 1917 Mr. Arthur W. Henn, curator of fishes at the Carnegie Museum of Pittsburgh, now on leave of absence from that institution, has been coöperating with Dr. Gudger in the preparation of the third or index volume, which is now nearing completion. This index is quite without parallel in biological literature; it opens up the subject of ichthyology from every angle, not only from that of natural history but also from that of medicine, of history, of chemistry, and of art. As to the precision with which this work has been accomplished from a strictly bibliographic standpoint, the Museum has recently received a testimonial of the first order from Dr. H. M. Lydenberg, reference librarian of the New York Public Library, who under date of July 17, 1922, writes to Doctor Dean as follows: "Yesterday afternoon it was my rare privilege to spend several hours going over the subject index to the bibliography of fishes now being prepared by Dr. Gudger. The personal interest I have felt in this bibliography, knowing both Eastman and Gudger as I have, must serve as an explanation of why I venture to write you now. I do not care to let the day go by, however, without expressing my congratulations on the conception of the bibliography and the index, and also on the admirable way in which this conception is now being realized. This work, once finished, will certainly fix a standard for future enterprises of like importance; and I am sure that the scientific world will owe you a debt of gratitude for having made possible this contribution to the two sciences of ichthyology and bibliography." H. F. O.

CUSK EELS.—Before his death Mr. William W. Welsh, of the United States Bureau of Fisheries, had gathered together a collection of miscellaneous fishes, taken in the Gulf of Mexico by the "Grampus," one of the boats of the Bureau. This collection has been sent to the American Museum where it is being worked up by Mr. John T. Nichols, curator of recent fishes, and Mr. C. M. Breder, Jr., who prior to becoming connected with the New York Aquarium was assisting Mr. Welsh in the study of this very material. The first results of the investigation have been published under the joint names of Mr. Nichols and Mr. Breder in the *Proceedings of the Biological Society of Washington*. The paper is a contribution to our knowledge of American cusk eels, which because of their rarity and because of the fact that they are found in water of some depth have been very imperfectly known. The three genera considered,—one represented by a new species, *Otophidium welshi*,—show a peculiar tendency in the degeneration of the scales. *Lepophidium* is the most generalized of the three and the scales, although very small and arranged in an unusual way, are yet like those of normal fishes. The scales of the more specialized genera are, on the other hand, rudimentary, embedded, and linear, and are arranged in groups that are approximately perpendicular to one another,—a condition identical with that in the common eel and a very striking case of parallelism if, as is believed, the eel is in no wise related to these cusk eels.

In return for the facilities extended by the American Museum in this investigation, some valuable specimens of the species examined have been obtained from the Bureau of Fisheries.

VERTEBRATE FOSSILS

COLLECTING FOSSILS IN SUN-SCORCHED INDIA.—With the aid of a generous contribution from Mrs. Henry C. Frick, the American Museum has sent one of its most highly trained and expert field collectors, Mr. Barnum Brown, into the classic region of the Siwalik Hills of western India. Mr. Brown was most cordially received and aided by Dr. C. E. Pilgrim and other officers of the Geological Survey of India. Doctor Pilgrim first directed Mr. Brown's work toward the Middle Siwaliks where an extremely valuable collection of fossil mammals of many kinds was secured.

As to fossil collecting in India during the torrid season, Mr. Brown writes President Osborn, June 21, 1922: "After many weary days of vexatious delays and difficulties, my Middle Siwalik collection is at last boxed and stored in the railroad station at Chakwal ready for shipment to Calcutta. I have arranged to keep it there until I bring in whatever I collect from the Lower Siwaliks at Chinji, and send all together in a separate car straight through. It will cost double freight, but I don't dare risk having coolies shift these heavy boxes at three transfer stations. . . . Some of the difficulties I have encountered in making this collection will interest you. It took one week

to build a passable road for carts out of the bad lands, and then required four bullocks and twenty-one men to move each mastodon skull. Fourteen days were consumed in transporting these skulls sixty-five miles, thirty-five of which were without road. The Indian countryman does not know how to work except in the grain field, and as he eats nothing but bread and chili, he has the strength of a small boy. . . . Traveling is done at night now for the daily temperature in the Punjab averages from 100 to 115 in the shade and around 200 in the sun. It is the most taxing heat I have ever endured. . . . It is difficult to secure adequate boxing lumber for big specimens. Parts of my material came from America, and the rest had to be sawed by hand on the spot. I have used flour paste for bandages, as plaster is not obtainable.

"I collected thoroughly all the Middle Siwalik series for a distance of twelve miles up and down the Sohan River from Dhok Pathan, and there are equally good exposures yet untouched for a distance of ten miles above where I worked. I doubt, however, if many species new to our collection would be obtained by further work in this region, so will go on to the Lower Siwaliks at Chinji. . . . The big specimens have used up much more time than I anticipated, so I am far behind my schedule, but unless I hear from you to the contrary, I shall continue my itinerary as projected, namely, the Lower Siwaliks at Chinji, afterwards the Upper Siwaliks at Chandi and Moganand, the type locality of the early Siwalik collections. This will give us representative collections from the Upper, Middle and Lower series. On account of the heat at present the Bugti Hills are impossible until later in the year, so I have decided to await your further advice."

RESTORING THE FOSSIL MAMMALS AND MEN.—The American Museum has been endeavoring to give scientific value to its restorations of extinct mammals and reptiles ever since the first efforts of this kind were made by Mr. Charles R. Knight in 1906, under the direction of Professor Henry Fairfield Osborn. This explains why the restorations are regarded as standards of their kind in many of the museums of the world and are eagerly sought for by journalists. As our knowledge of the animals is increased or modified by discovery, the original restorations are replaced by others embodying the new information. Professor Osborn is planning with Mr. Knight to revise the entire series, which now includes upward of fifty mammals and reptiles, bringing all the restorations abreast with our most recent knowledge. The comparative anatomical study of extinct animals, introduced under Curator William K. Gregory and under his direction carried to such a point of perfection by the late Mr. Erwin Christman, and the fact that Curator Gregory's students have been devoting a great deal of time, with important results, to the study of comparative anatomy and the musculature of vertebrates, have placed the Museum in a position to reach a still higher degree of accuracy than ever before. The knowledge at its disposal has been expressed in very carefully prepared models like the *Camarasaurus* and *Brontotherium*, figured in NATURAL HISTORY, November-December, 1921, pp. 620-25.

The restorations of fossil men by Dr. J. Howard McGregor, research associate in human anatomy, American Museum, have been based on sound scientific principles; in fact, they embody the most carefully revised and exact measurements and the most thorough methods that have ever been instituted for work of this character. The restorations of the heads in particular of these fossil men have passed through several stages as our knowledge has been perfected by successive discoveries. The result is that the models that Doctor McGregor has made of the Trinil man (*Pithecanthropus*), of the Piltdown man (*Eoanthropus*), of the Heidelberg man (*Homo heidelbergensis*) and of the Neanderthal man (*Homo neanderthalensis*) and finally of the Crô-Magnon man (*Homo sapiens cromagniensis*) are eagerly sought for by museums in various parts of the world, and have been of especial value to educators and to journalists.

The American Museum is now undertaking a far more difficult and expensive task in the complete restoration of the body of Neanderthal man, having sent Doctor McGregor on a special journey across the Atlantic to study all the European collections with a view to securing the fullest data and by purchase and exchange enriching the Museum collection of casts and replicas. There are still many misconceptions regarding the pose, the stature, and the bodily appearance of Neanderthal man which Doctor McGregor is in a position to correct as an outcome of his long and intensive research. He is now engaged in putting together the results of all his observations and measurements and in modeling a complete skeleton of Neanderthal man, which, when ready, will be placed in the hall of the Age of Man, beside the complete restoration of the body, above alluded to, on which he is also engaged.

GEOLOGY

AWARD OF THE GAUDRY MEDAL TO PROFESSOR OSBORN.—Just at the close of the World War the Société géologique de France awarded the Albert Gaudry Gold Medal, the highest distinction which the society confers, to Professor Henry Fairfield Osborn, honorary curator of

the department of vertebrate palæontology, American Museum. The medal has been received recently by Doctor Osborn, accompanied by the following letter from President A. Lacroix of the Society:

Paris, July 11, 1922

MY DEAR COLLEAGUE:

The Société de géologique de France awarded to you in 1918 the Gaudry Medal. In selecting you, during the progress of the war, as the recipient of the highest distinction within its power to express, it wished to evidence to you the esteem in which it holds your fine scientific works and at the same time to express most cordial interest in American science.

I am pleased that the fact of my being president affords me the privilege of transmitting to you this tangible evidence of the admiration of your colleagues, the French geologists. The Ambassador of the United States has graciously undertaken the delivery of our gift. I am certain that this proof of good feeling will enhance the award in your eyes.

Accept, my dear Colleague, the assurance of my high respect and of my very cordial good wishes.

The President of the Société géologique
Secretary in perpetuity of the
Académié des Sciences
A. Lacroix.

"THE ORIGIN AND EVOLUTION OF LIFE"

A FRENCH ESTIMATE OF PROFESSOR OSBORN'S WORK.—A French translation, prepared by Félix Sartiaux, of Professor Henry Fairfield Osborn's *The Origin and Evolution of Life* recently made its appearance under the imprint of Masson et Cie of Paris. The book has been warmly received by French scientific circles and citation may be made from a representative review published in the Paris *Temps*:

"The theory which Dr. Henry Fairfield Osborn, the eminent palæontologist, president of the American Museum of Natural History, propounds in a book of commanding interest doubtless does not escape the charge of being an hypothesis. It must be considered, however, as representing, according to the new physico-chemical conceptions and the recent researches regarding colloides, the point reached by our actual knowledge. It is certainly a remarkable effort toward a scientific comprehension of that which one might be tempted to place in the domain of the unknowable if one had not accustomed one's self to being astonished no longer by any discovery of science, however unexpected."

After a survey of various phases of the book, the review closes as follows:

"We are not able to follow the author through that captivating vista of the evolution of living forms, passing from algæ to the higher plants, then to the animals. Our too brief summary consequently gives only an imperfect idea of the grandeur of the structure he has been able to erect and of which the theory of the origin of life is only the beginning. In the course of the work organisms of the most complicated type are considered from the standpoint of energy, as well as from the morphological viewpoint. The undeniable ability of Osborn gives to this part of his study a very special value, and nothing is more interesting than his conception, to which we can only allude, of the great prob-

The Gaudry Medal of the Geological Society of France, awarded in 1918 to Dr. Henry Fairfield Osborn, honorary curator of the department of vertebrate palæontology, American Museum, in recognition of his work in geology and in palæontology

lems of heredity. His explanation of life will doubtless have influence in turning many research workers towards that study of colloides upon which we rightly base great hopes."

FOREIGN RECOGNITION OF THE ACCOMPLISHMENTS OF THE AMERICAN MUSEUM.—Apropos of the translation into French of *The Origin and Evolution of Life*, it is of interest to cite a passage from the preface by Félix Sartiaux, the translator, in which the notable development of the American Museum of Natural History under the presidency of Professor Osborn is given full recognition.

"Palæontologist of the United States Geological Survey, president of the New York Zoölogical Society, president of the Marine Biological Association, Professor Osborn has made the American Museum of Natural History a great center of information, maintaining constant relations not only with the scholars of America and of foreign lands, but with travelers, whom he interviewed before their departure and questioned upon their return, with captors of animals, with those organizing public gardens or making zoölogical collections. The knowledge gathered has been disseminated among the public through conferences, through guide books constantly kept up to date, through fine periodicals remarkably illustrated, such as *The Journal of the American Museum* and its successor, NATURAL HISTORY. A museum planned in this manner is not a mere shrine to which repair a few initiates; it is a hearth of life, an institution ever progressing, constantly undergoing renovation, an instrument of education and of national improvement. The scholar and the man of action are thus represented in the productive activity of Doctor Osborn, who has exercised a powerful influence upon the biological circles of America and has contributed to the founding in that country of a flourishing school of young palæontologists."

MAMMALS

MAMMAL COLLECTING IN ECUADOR.—Mr. G. H. H. Tate has been for some months in Ecuador collecting mammals, and to some extent reptiles and batrachians, for the American Museum. His search has taken him from sea level to altitudes more than twelve thousand feet in height. Here weather conditions were often unusually severe, the nights being intensely cold, and rain and mist adding to the collector's hardships; but full of perseverance, he wrote: "I wanted the highest point where life was at all bearable."

In a shipment just received from Mr. Tate are about three hundred mammals, including species undoubtedly new to science in addition to others that are scarce. Among the latter are three specimens of the rare marsupial *Cænolestes*, which was for a long time known from only one or two specimens and the habitat of which was a matter of conjecture. In recent years, however, more has been learned of this primitive creature through specimens taken by Dr. W. H. Osgood in Venezuela and by Mr. Edmund Heller in Peru.

A number of bats were collected in the course of the trip. Some were found in a baggage room in the station at Duran, others were obtained from a disused textile factory in Cuenca. What was described to Mr. Tate in Pescado as a cave big enough to hold a hundred men and from which a large haul of bats was to be expected, proved on examination to be merely an overhanging ledge of granite in the face of a cliff and yielded no bats whatever.

Although a large number of the smaller mammals have been secured by Mr. Tate, the larger cats and bears have as yet evaded him. He has, however, seen the tracks of both and in one instance had a striking demonstration of the voracity of the jaguar. All that remained of the wild pig that the huge cat had killed was the hair. In the scuffle that had preceded the act of devouring, the jaguar had had one of its claws torn out and this Mr. Tate preserved.

Mr. Tate was recently joined by Mr. H. E. Wickenheiser, who will act as his assistant. Mr. Wickenheiser is a Cornell student interested in natural history, who plans to return to his Alma Mater in the spring.

A RECENT CONTRIBUTION TO THE DISCUSSION OF EVOLUTION

AN ADDRESS BY DR. W. W. KEEN.—In the commencement address delivered before Crozier Theological Seminary, June 6, 1922, and subsequently published in the *Public Ledger* of Philadelphia, Dr. W. W. Keen, the distinguished surgeon, made a notable contribution to the discussion of evolution. The many fundamental resemblances which the comparative anatomist finds between the human structure and that of animals superficially different from man are a convincing proof of the solidarity of the animal kingdom, inclusive of man. During the fifty-five years that Doctor Keen has been practising his profession, he has been able again and again to diagnose human ailments of baffling character by applying to them his knowledge of the location of the motor centers in animals. Experiments on animals having revealed just where lie the centers that control the muscles of the face, the arm, and the leg, it is possible by analogy to determine what portion of the brain has been injured when—for instance, through a blow upon the head—a human individual has lost the motor control of one or another of these parts. The fact that the location of these motor centers is the same in man as in the animals is a striking bit of evidence of their relationship.

Wild antelope coming up to the feeding ground on the Mount Dome Antelope Refuge, Siskiyou County, California. This refuge was established November, 1921, under the auspices of the California Academy of Sciences, the California Fish and Game Commission, the United States Forest Service, the New York Zoölogical Society, and the American Bison Society

AN ACQUISITION TO THE OSBORN LIBRARY

A GIFT OF "BREHMS TIERLEBEN."—The American Museum is greatly indebted to Dr. Alfred Lotichius, of Frankfort on the Main, a life member of the Museum, for his gift of the complete set of the fourth edition of *Brehms Tierleben*. This splendid work covers the entire natural history of the world; it contains 2000 text illustrations, 500 beautiful colored plates by the leading artists of Germany, and 13 maps of geographic distribution. The Osborn Library has recently received from Doctor Lotichius six additional volumes, bringing the series up to the thirteenth volume, published in 1916, and including the Mammalia of the world, with beautiful illustrations of some of the newer forms of mammalian life, like the okapi. The American Museum keeps in close touch with the remarkable Senckenberg Museum of Frankfort, of which Doctor Lotichius is one of the trustees, and Professor zur Strassen, the director.

CONSERVATION

THE CALIFORNIA ACADEMY OF SCIENCES.—Through a committee of which Mr. M. Hall McAllister is chairman, the California Academy of Sciences is actively interested in preserving the valley elk, the mountain sheep, and the antelopes. The elk and the sheep are able to forage for themselves and need only protection; but the antelopes, because they are more and more restricted territorially, have to be fed and cared for through the winter. There are now in California five bands of antelopes, totaling 200 animals; one band of valley elk, consisting of 350 animals, and 100 elk in paddocks; and 20 or more flocks of mountain sheep, comprising possibly 1000 head, in the desert mountains of southern California and the Sierras. To calculate the number of mountain sheep with even approximate accuracy is necessarily a very difficult task, but it is one which the committee in question has set itself as a part of its labors. Through the courtesy of Mr. McAllister NATURAL HISTORY is able to reproduce a picture of the Mount Dome herd of antelopes in "company front" formation. This herd, Mr. McAllister states, is the finest, most compact, tamest, and most accessible herd in the West, barring possibly the Yellowstone Park herd.

OTHER INSTITUTIONS

THE PUBLIC MUSEUM OF THE CITY OF MILWAUKEE.—In addition to its *Annual Reports* and its *Bulletins*, the Public Museum of the City of Milwaukee will henceforth issue a *Year Book*, in which will be presented in popular form accounts of the field expeditions and similar activities of the institution, the acquisition of collections, the installation of new exhibits, and special studies in which the various departments may be engaged.

The initial number of this new publishing undertaking, edited by Dr. S. A. Barrett, sets a standard in respect to substance and form which, maintained in subsequent issues, will give the series an assured prestige. In addition to a number of handsomely illustrated articles written by the scientific staff, recounting recent field work undertaken mainly in Wisconsin, there is a contribution by the librarian, Dr. Carl Thal, tracing the early history of the Public Museum.

In 1857 a German educator, Peter Englemann, who was himself an enthusiastic student of nature and who desired to kindle that interest in others, was instrumental in establishing the Naturhistorische Verein von Wisconsin. The collections of this natural history society grew so rapidly that by 1882 the society was no longer in a position to take care of them adequately. It was then that, through an enabling act passed by the Wisconsin Legislature, the directors of the society were authorized to convey their collections to the city, and the city through a supplementary act was empowered to receive the objects transferred.

In 1883, the Board of Trustees of the Museum that came into existence under these circumstances, elected as its first president General F. C. Winkler. During the succeeding seven years the museum grew rapidly through purchases and gifts, and the need for additional exhibition space became a pressing one. In 1890 the present site of the museum on Grand Avenue was purchased by the city of Milwaukee, and in 1896 work on the edifice was begun. An important development took place in 1906 when the Common Council passed a resolution establishing an Historical Museum as part of the Public Museum. The Historical Museum, erected on a site adjoining the original building, was completed in 1912.

The Public Museum performs an important educational service. About 90,000 people annually attend the lectures given under its auspices, and lantern slides, motion picture films, and specimens are supplied by it to the schools and other educational agencies.

INTERNATIONAL COMMISSION OF EUGENICS.—A meeting to discuss the various administrative matters of the International Commission of Eugenics was held in Brussels, Belgium, from October 1 to 9.

SINCE the last issue of NATURAL HISTORY the following persons have been elected members of the American Museum:

Annual Members: MESDAMES FRANCIS J. DANFORTH, H. R. MILLER; DOCTORS H. G KUGLER, ERNST LEHNER, LOUIS VONDERSCHMITT; THE REV. GEO. G. HOLLINGSHEAD, D.D.; MESSRS. HARRY B. CANTOR, GEORGE A. EYER, JR., HARRY L. FERGUSON, HOWARD CROSBY FOSTER, CARROL H. HUDDLESTON, CLARENCE VAN S. KIP, FRED. H. PEPER, JR., WILLIAM L. RANSOM, and RUFUS W. WEEKS.

Associate Members: MESDAMES FREDERICK A. GEIER, MABEL STRONG HESELTON, JULIA S. LUCKY, J. F. MERRILL; the MISSES DOROTHY BAILEY, EDITH WEST; DR. MAURICE V. TYRODE; PROF. JACK J. HINMAN, JR.; MESSRS. NEWTON G. ARMSTRONG, CHAS. H. BAKER, R. R. BANE, CHARLES L. BARRETT, WILBUR L. BROWN, STEPHEN DEMMON, DUDLEY GRANT HAYS, HERBERT K. JONES, JOSEPH N. LA RUE, MARSHALL L. MURRAY, KARL A. PEMBER, J. M. ROGERS, C. G. SCHLUEDERBERG, H. W. SCHMIDT, JAMES SCOTFORD, FRANK N. TANDY, R. G. VAUGHN, and H. E. WILSON.